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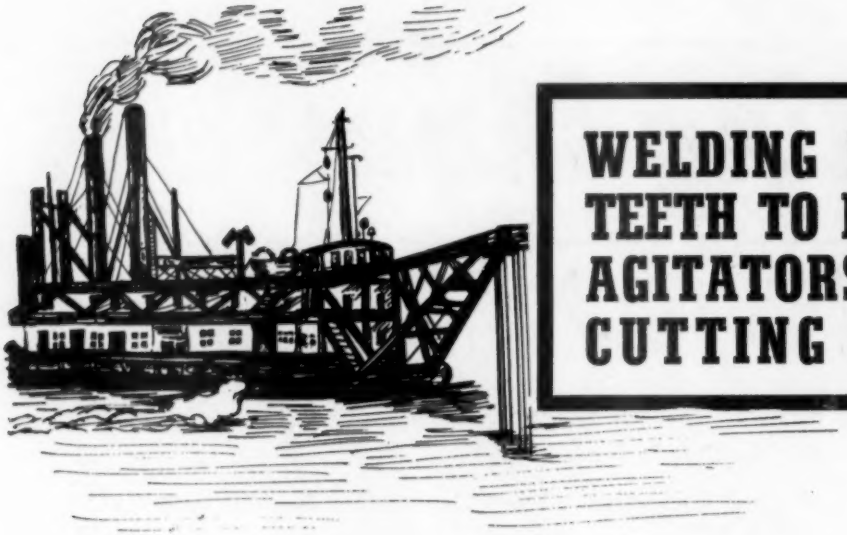
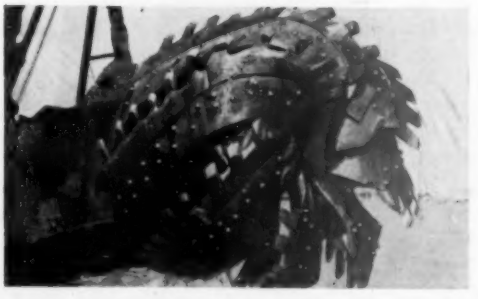


WELDING HARD-FACED TEETH TO DREDGE PUMP AGITATORS INCREASES CUTTING EFFICIENCY

Deepening a channel proved to be a tough job for a certain dredging company, because the bottom of the channel was composed largely of clay which had a tendency to ball up when the conventional type of agitator blade was used.

The difficulty was partially overcome by welding a number of .50 carbon teeth to the manganese blades with 18-8 stainless steel. These teeth improved the cutting efficiency of the agitator, but they dulled quickly. A Stoody representative persuaded the superintendent of the dredging concern to try facing the teeth with Electric Tube Borium. The teeth faced with this material outlasted the ordinary teeth by a ratio of three to one and more important, they stayed sharp. The illustration below shows the teeth after several weeks' service. It will be noticed that they are just as sharp as when they were put into service.

If you have some problem involving abrasion, call in your Stoody representative. He will be glad not only to suggest the proper type of hard-facing alloy, but also to help you work out the best method of application.



RIGHT—The photograph illustrates the appearance of the hard-faced teeth after several weeks' service

STOODY COMPANY
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Standard Terminology

ENGINEERING IS AN exact science. As such it recognizes the practical value of a standard terminology to eliminate confusion and misunderstanding. The American Welding Society, for example, has adopted standard definitions of technical terms commonly used in welding. The recent development of new oxy-acetylene applications has opened up several new industrial fields. As pointed out in our January, 1940, Annual Progress Issue, recent years have seen new fields of application opened up such as flame-treating, which covers the processes of flame-hardening, flame-softening and flame-strengthening. To this list of hyphenated terms must be added the following processes: flame-cleaning, flame-desurfacing, flame-descaling, flame-deseaming, flame-scarfing, flame-skinning, flame-gouging, flame-dehydrating and flame-conditioning. Many people do not know for certain to just what processes these terms apply.

Owing to the increasing industrial use of these new "hyphenates," we feel there is considerable chance for confusion, unless the proper technical authorities get together and adopt a standard terminology. It is recognized, of course, that until application developments become more stabilized, it is extremely difficult to set up a system of standard definitions. We believe, however, that a competent technical committee should tackle this problem at an early date, or at least just as soon as developments seem to be ready for a more uniform and more definite nomenclature.

Slightly Unorthodox

RESEARCH REPORTS ARE usually pretty dull reading, because the men who write them attempt to describe every phase of a research project in the most minute detail. The reader has to be keenly interested, indeed, in the subject of the project in order to stick with the author to the bitter end. Another aggravating characteristic of most research reports is that they generally assume too much technical background on the part of the reader.

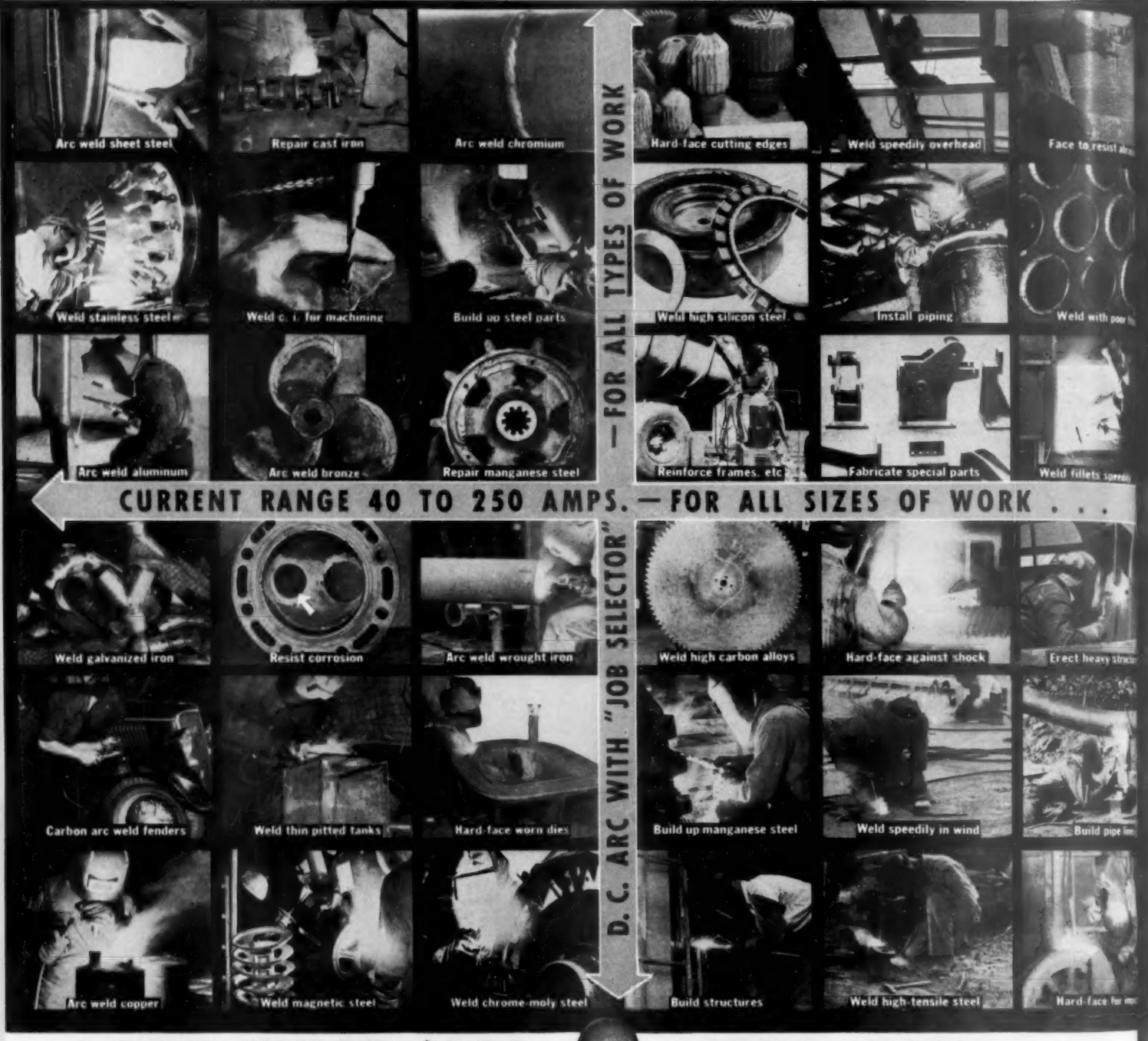
Report No. 670 "Tensile-Elastic Properties of 18-8 Chromium-Nickel Steel as Affected by Plastic Deformation" is no exception to this aforementioned statement.* The report describes certain phases of an investigation, sponsored by the National Advisory Committee for Aeronautics, of the tensile-elastic properties of an 18-8 stainless steel. In the annealed condition, this corrosion-resistant alloy is relatively soft. As stated in the report, this alloy can, however, be strengthened by cold work, but not to an important degree by means of heat treatment, according to these researchers. As its strength and elastic properties depend on the degree of cold work, this research work considered the influence of such cold working on the elastic properties.

To read the body of this report would demand the most intensive type of concentration, plus a substantial technical background. However, the authors, D. J. McAdam, Jr. and R. W. Mebs, have "saved the day" by including a well-written summary of their work, which almost any one can read and understand. In this summary, we find some rather unorthodox technical ideas, for example: "The investigations of Hopkinson, Williams and Rowett, however, have shown the existence of mechanical hysteresis at ranges of stress far below the plastic range. The investigations of Sayre have confirmed these conclusions and have led to the view that hysteresis exists within any stress range. Such hysteresis, although it is generally called "elastic hysteresis," is evidence of imperfect elasticity. According to the evidence, therefore, metals probably are not perfectly elastic at any stress." Welding engineers should note what effect this may have upon dissipation of internal stresses.

"Even the technically determined limits of elasticity are altered by overstress. Although the stress-strain relationship may be approximately linear before overstress, the relationship becomes curvilinear when the metal is retested immediately after release of the overstress. Rest of some overstressed metals at room temperature restores the stress-strain line to its original form. Restoration is hastened, however, by heating to 80-100 deg. C. or slightly higher."

A general term is needed to designate any type of deformation occurring without increase of load. The word "creep" frequently used with this meaning, is so used in this report. Apparently there is slow deformation under the loading imposed by residual stress, although the authors do not make any reference to this possibility. There is thus suggested, a promising field for additional research work on the mechanism of internal stress dissipation.

*This is a Bureau of Standards research report. Copies are available at 15 cents from the Superintendent of Documents, Washington, D. C.



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Railroad equipment builders use

Welded Low-Alloy Steels

★ Welded assembly reduces load stress concentration—Attention is directed to importance of impact strength (notch toughness) in severely cold weather as criterion of steel's value to car builders

By HOWARD L. MILLER
Metallurgical Dept., Republic Steel Corp., Massillon, Ohio

TO REDUCE the dead weight of railroad cars and consequently reduce the cost of hauling them over the rails, low-alloy, high-tensile steels are being increasingly used in place of ordinary structural steel.

Welding, as now handled in the shops of car builders and railroads alike can compete, even on ordinary steels, with the cost of other types of construction. Moreover welding assembly reduces stress concentration and so is much more desirable in this type of work. Reducing the gauge or thickness of sheets and structural members, of course, raises the working stresses, because of their higher elastic limit and higher tensile strength. Even so, of course, it is important to hold to a minimum such stress concentrations as are unavoidably present in any type of car design.

These low-alloy steels cost more per ton than the ordinary structural steels of high carbon content. As previously stated, they possess a higher elastic limit than ordinary carbon steels, but owing to the fact that that design limitations sometimes prevent reducing the thickness of sections to the minimums theoretically permissible, the net cost of steel used per car is generally higher with low-alloy steel than with the ordinary copper-bearing structural steel. To offset this increase in material cost, the fabricator must keep his assembly cost as low as possible and practical in order to keep down the cost of the completed car. The lower the initial cost of the car, the sooner the operating savings will compensate for the higher material cost and commence to return a profit resulting from use of newer steels.

High Notch Toughness

From a welding standpoint, railroad car builders demand a steel that does not require any special precautions or heat treatment beyond what are required for ordinary mild carbon steel. They want a steel which will form readily, either hot or cold, and one which possesses a high degree of notch-toughness in the as-rolled condition. Moreover, the steel must be able to retain this toughness without additional heat treatment after hot forming and in the as-welded condition.

To put it another way, the metallurgical problems involved in the welding operations must be met by the steel producer in such a way that the welder, using a low-carbon coated rod, or a spot welder, or continuous automatic arc welder, can proceed with the operation equally as well on low-alloy steel as on ordinary structural grades of steel.

Underframes of cars are subjected

Assembled truck frame in welding jig.

to heavy alternating stresses in tension, compression and shear, in starting, stopping and when taking up the slack in long trains. The as-welded underframes must be able to withstand these shocks through low winter temperatures where most steels lose a considerable amount of their shock resistance. In fact, the few failures in welded and in some riveted parts that have occurred, have been found to be due to a low value of notch-toughness (impact strength) in cold weather. As a result of these few failures, the notch-toughness of steel, either as an ordinary nick-break test, or as a Charpy or Izod value, is becoming very important to operators of railroad cars. It is entirely probable that steel producers will have to accept minimum values on Charpy or similar tests for plates and shapes used in underframes and also in bodies of open top gondolas and hopper cars.

It has been definitely proved that a steel which shows a crystalline fracture on nick-break testing is not in a suitable condition for shock-resistant service. So far the only way that steelmakers have found to produce an "as-rolled" steel to meet these specifications and retain them without heat treatment after welding is to add about 1% of nickel, keep down the phosphorus and air-hardening elements, and reduce oxygen and possibly nitrogen in the material. Proper temperature control on the finishing mills is, of course, a help also; but steel cannot be made on the rolling mill.

Railway car builders all follow the same general methods of construction. The cars are assembled on main assembly tracks, where the complete sub-assemblies of underframe, sides, ends, and roof are brought together. Bolsters, cross-bearers, and cross-ties as a rule are sub-assemblies welded in jigs before attaching to the center sill which is the backbone of the car. A standard center sill is made up of two large Z sections welded together on their top flanges to form an inverted U box-section about 13 in. square and varying in thickness from ½ to ⅝ in., according to strength of the material. About 60 to 75% penetration is all that is required in the welding of these parts in their longitudinal direction. This weld is possible to make either by hand or by automatic machine.

Production line in Milwaukee shops for building sides and roof of caboose.

Sub-assembly work is also done on the ends, sides, and roofs before they come to the main assembly line. The main job is to co-ordinate the various operations and balance the machines and welders so that an even flow of the proper amounts of each required part will reach the main assembly track as needed. A small bank of various parts and sub-assemblies should be maintained so that delay in any one department will not shut down the main assembly line.

In 1934, the "Milwaukee Road" car department, under the direction of K. F. Nystrom, began construction of cars in their Milwaukee shops by the welding process.

Passenger Train Cars

In the last 5 years this railroad has built and put into service a total of 216 all-welded passenger cars. These cars are all of low-alloy high-tensile steel. They conform to streamlined design and use an all-welded construction.

A sleek looking welded caboose just off of the production line.

Close-up of welded roof construction of a "Hiawatha" passenger coach.

Interior of a "Hiawatha" passenger coach. Side panels of welded low-alloy steel.

Their strength permits of interchange with cars of the heavier conventional type. These cars are used in the four streamlined high-speed "Hiawatha" trains now in service between Chicago and Minneapolis. A maximum speed of 100 m.p.h. is attained at several points on this journey. Average weight of cars is 96,000 lbs., or about 40% lighter than the old style cars of conventional (carbon steel) construction. Lighter weight cars enable the train to operate at a greater speed.

During this period these cars have been subjected to very severe service conditions and the results have shown that the lightweight design and all-welded construction are safer than most of the old style cars in operation. Increased safety, together with greater economy in operation have more than justified adoption of the new cars.

Freight Train Cars

During this same five-year period a total of 5,193 freight cars of all-welded construction have been completed by the "Milwaukee Road," or were under construction in 1939. Another 2,000 cars are authorized for 1940. Copper-bearing steel is used in the construction of part of these cars and the others are of low-alloy high-tensile steel. Welding procedure and technique, however, is practically the same for each steel.

On 50-ton, 50-ft. alloy steel automobile cars, the reduction in weight as compared with the A.A.R., or representative average design, amounts to 9,000 lbs., and on the 40-ton automobile and 50-ton box cars, the saving is 6,000 lbs. This gives a total dead-weight saving of 9,567 tons on the 2,689 lightweight cars which have been built. This number of tons represents a total annual saving of about 114,804,000 ton-miles (average freight car runs 12,000 miles per year).

This road recently completed 75 all-welded low-alloy steel cabooses for freight train crews. These cars represented a saving of 7,000 lbs. per car under similar cars of regular steel construction. Naturally, they are much stronger and safer than the older wooden type cars. These cars will be used in heavy main line service. The railroad estimates that they will cost about $300 less per year to operate than the older type cars.

Production Statistics

Here are a few figures in connection with the production of welded alloy steel box cars in the "Milwaukee Road" shops. Current production is at the rate of 12 complete cars per day. Each car requires about 6,000 spot welds, 1,190 ft. of fillet welds on 3/16-in. or lighter steel, 170 ft. of fillet or butt welds on ¼-in., or heavier steel, about 200 lbs. of welding electrodes per car, and about 380 kwh. per car of electrical energy. The total man-hours for welding operations is about 79 per car. A complete day of operations on 12 cars means completion of 72,000 spot welds, 14,280 total feet of arc welding, using up 2,400 lbs. of shielded welding electrodes.

The 50-ton hopper cars (1,000 total) were produced at the rate of 15 complete cars a day and required depositing 1,100 lineal ft. of arc welding per car, using 195 lbs. of welding rod (per

(Continued on page 46)

Distinctive streamlined "beaver tail" rear end of a "Hiawatha" observation car. Yes, it is all welded.

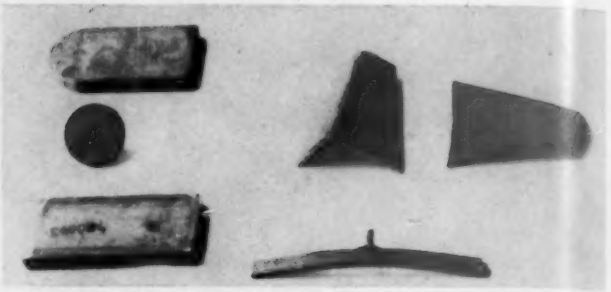


Fig. 20.—A bar, a magnetic flame cutter radius cutting templet and finished part are seen at left, and a bent plate with long-radius cutting templet used for shaping it are at right.

Fig. 21—Skillfully designed parts like these templets "nest," and may be cut in pairs with minimum work and scrap.

Welding economies made possible by

Machine Flame-Cutting

★ Part 3—How production templets are made—Mechanical flame-cutting is very useful in making special dies and machine repair parts

By ELMER E. ISGREN and WALTER J. BROOKING*

Plant Superintendent and Member of Engineering Department, respectively, R. G. Le Tourneau Inc., Peoria, Ill.

FIGURE 20 SHOWS the simplicity of templets used on a magnetic flame-cutter and the parts which they are used to produce. On the left, the sheared piece of bar stock has a simple radius cut on one end, using the templet shown between the sheared piece and the round-ended piece. The bent part in the center has a short cut on a long radius cut into it, which can be seen in the side view of the part. The simple bowed templet in the central foreground is used to guide the torch for the cut. An almost endless variety of cuts can be made on small parts with such simple templets on a magnetic flame-cutting machine.

Templets for the multiple-flame shape-cutting machine, illustrated by those in Fig. 21, are made for large production of parts. For single or only a few parts, the pieces may be traced from a paper templet.

The "production" templets are usually made of some rigid, light material which is not distorted by heat, light, moisture, or reasonable handling; to which an aluminum border is attached for the flame guide rollers to straddle. One factor which enters into the cost of such templets is that after a few thousand pieces have been cut, the guide rollers have worn the aluminum border to such a degree that it is necessary to replace it. The replacement is a simple and inexpensive matter, however, since it involves only the removal of the border from the original form of the templet and replacing it with a new border.

Careful and painstaking work is required in duplicating the original paper templet form in whatever basic material is used in the body of templet.

*Part 1 of this series of articles was published in January, 1940 issue, pages 35-37. Part 2 was published in February, 1940 issue, pages 22-25.

with whatever allowances are necessary in dimensions to adjust the form to the feed mechanism. Although precision is required in forming and attaching the aluminum border to the body of the templet, the making of such a templet requires only a short time. All such templets should be carefully finished, painted, and the part number which it cuts should be clearly marked on it before the templet is used on a job, or stored.

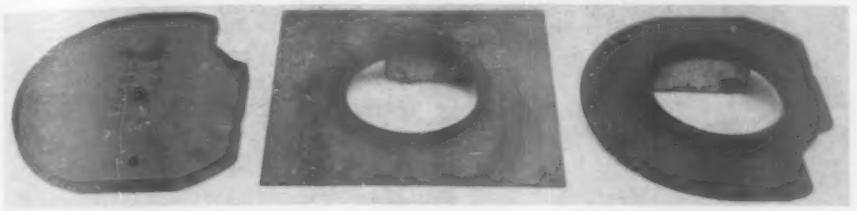


Fig. 22—A pressed plate, multiple-flame shape-cutting templet, and finished cut plate, a typical example of production operations on a mechanical flame-shaper.

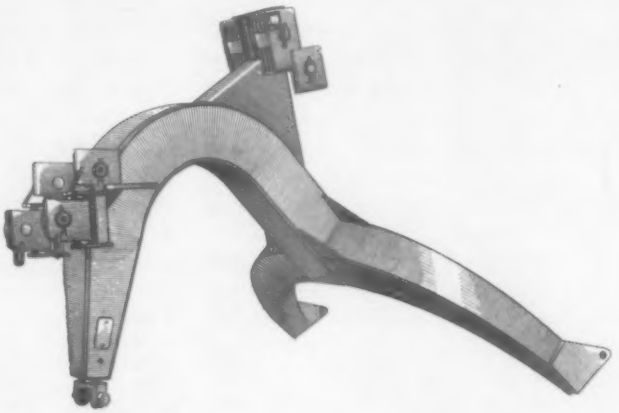


Fig. 23—Rapid and economical production of fabricated structures such as this is made possible by mechanical multi-flame shape-cutting machines.

In cutting large numbers of production parts which have a symmetrical difference, such as right and left templets shown in Fig. 21, it is often economical to make both templets and nest them together to save handling of plate, resetting templets on the machine, and added manipulation of the carriage and torches to utilize the whole plate and keep the scrap to a minimum.

The multiple-flame shape cutter is also readily adaptable to making finishing cuts on parts which have been sheared or sawed and partially finished, such as the embossed cover plate, blank, templet, and shape-cut cover plate blank shown in Fig. 22. As in cutting from plate, one templet is all that is necessary for the setup, so that three parts can be cut for about the cost of cutting one.

The great variety of shapes and sizes of parts which can be cut from plate on the multiple-torch shape-cutting machine on a production basis, using the aluminum bordered templet, is again shown by the all-welded structure shown in Fig. 23. Considering the complexity of curves and shapes involved, and the fact that every one of the main plates of the structure were cut on the multiple-torch shape cutter, and that only about half a dozen of the smaller parts were cut by methods other than mechanical flame-cutting, this assembly demonstrates the extent to which a resourceful designer can depend upon mechanical flame-cutting to produce a truly effective, economical, functional design. The structures shown in Fig. 23 are regularly ordered in quantities of 50.

Duplication of Parts

A mechanical flame-cutting machine is a very useful piece of equipment in the development of new equipment, making special dies, making new parts for the repair of machines, or in any case where there is a need for cutting one or a few special parts. The technique employed in such cases is simply to fasten the paper templet which is furnished by the engineering department to the machine table and follow its outline with the tracing attachment.

By means of the tracing method, the cutting of a special part to very precise tolerances can be made a matter of a few minutes from the time it is released by the engineering department. It is absolutely essential that the ma-

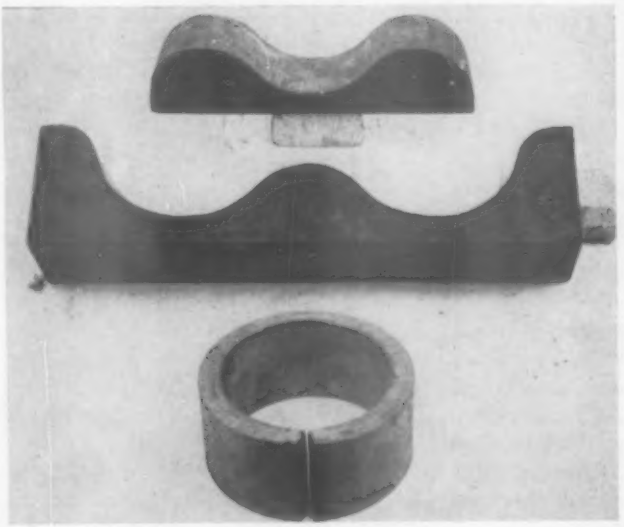


Fig. 24—A very practical application of flame-cutting to press dies. The first of two operations in shaping the band shown at bottom was performed with the punch and die shown on left.

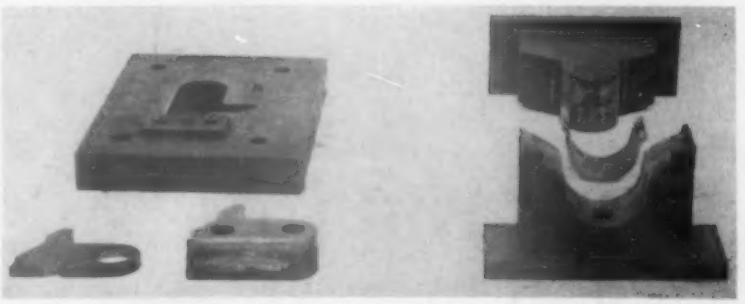


Fig. 25—With flame-cutting equipment at his command, the resourceful die maker can readily fashion dies such as these.

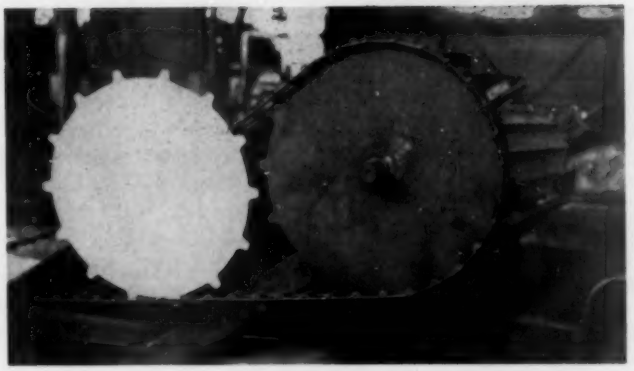


Fig. 26—One hour from broken casting to permanent steel sprocket via mechanical flame-cutting.

chine be in first-class operating condition and that the operator exercise skill and care in manipulation of the machine while tracing.

The large bending die shown in Fig. 24 was cut from 5-in. plate by simply tracing the cuts. It is not uncommon to place such dies in operation without any dressing or finishing of the flame-cut surfaces. The cuts can be made smooth and square enough to give perfect service for many hot or cold-bending processes.

Blanking Dies

Another very practical and economical application of the tracing method for making dies is the cutting of blanking dies from plates of die steel. An example is the blanking die shown at the left in Fig. 25. The die on the right is much like the bending die shown in Fig. 24, including one of the pieces which is hot pressed in it. Both the blanking base and the punch were mechanically flame-cut from preheated 2½ in. die steel plate by tracing the paper templet of the part. However, the punch cannot be made from the piece cut out to form the blanking base, because removal of the kerf leaves the piece too small to serve as a punch. The blanking die and punch shown in Fig. 25 was made with a hard-faced cutting surface deposited by the arc on flame-cut pieces with a minimum of dressing. When placed in service it punched 1600 blanks from hot ¾ in. alloy steel, all of which were well within the required tolerance.

Figure 26 illustrates another timely application of the tracing method on flame-cutting machines as a means of saving time and money. The two-foot sprocket shown with its heavy paper templet represents the practical repair of a cast-iron sprocket which failed in service. The sprocket was simply laid out on heavy paper, and the blank was flame-cut from steel plate by tracing. The flame-cut sprocket was arc welded to the shaft as shown and was in satisfactory service before the heat of the flame-cutting had dissipated from the newly made wheel.

An almost unlimited variety of pulleys, gear blanks, sprockets, rocker arms, levers and other odd-shaped parts can be made in the same manner, after the original cast-iron part has failed. A somewhat more complex application of the redesign in flame-cut steel, after failure of the cast-iron part, is illustrated by the oil pan for a 70-ton hydraulic press shown in Fig. 27. The cast-iron part failed and was replaced. When it failed again, the circular members in its design were traced and flame-cut from steel plate. Then steel bars were rolled and set up and tack welded to the circular plates. This whole structure was then welded and machined. It has given perfect service.

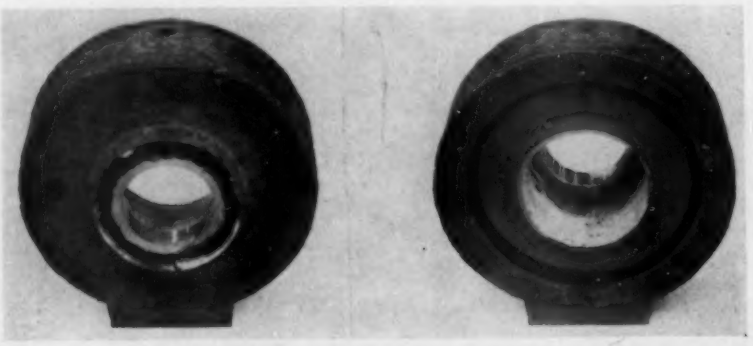


Fig. 27—Mechanically flame-cut parts played a major part in redesigning this part from cast-iron.

In the final analysis, the mechanical flame-cutting machines, as accessory tools go hand-in-hand in the mass production of modern machinery by the arc welded process. There is no other method or tool known which can be used to produce such a wide variety of sizes or shapes, in numbers from one or two parts to several thousand—each a duplicate of the first—and all within the close tolerance required for the arc welded process of fabrication. No other shape producing method can be so effectively and universally applied within such a short time and at such a low cost to the wide variety of problems confronting the progressive arc welding designer or resourceful manufacturer of arc welded products. Truly, the mechanical flame-cutting machine is an indispensable servant in arc welding.

» «

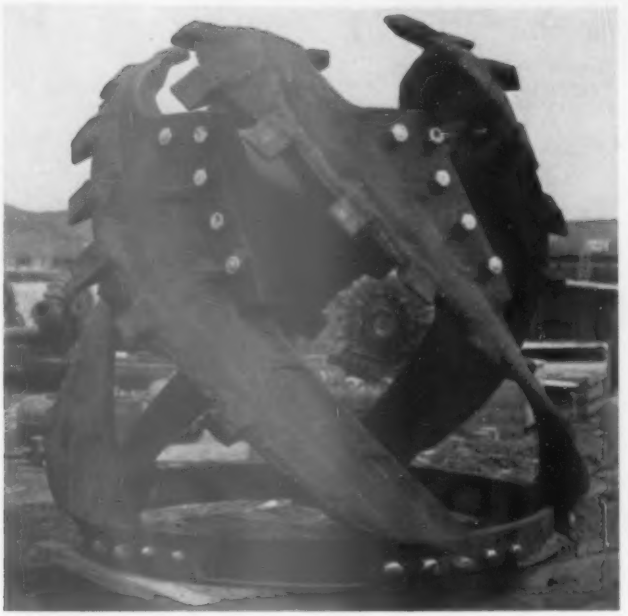
Welder Assures Oiler's Footing

By C. C. LYNDE

★ Rather than be burdened with a portable ladder, oilers were climbing the frames of pumping units under their charge, finding precarious and unsatisfactory footing in the angles formed by intersection of braces with corner posts of the pump frame.

To provide firm footing at these points, the welder set in short lengths of ½ in. round rod, welding it to frame and brace to form a level step, wide enough to accommodate one foot, with brace and corner post to prevent side slip. These bits of rod were found to effect appreciable savings in time required for oiling. Service records indicated that more thorough lubrication was being secured, since oilers were afforded a solid footing while checking and oiling the bearings.

6-in. lengths of ½ in. round rod welded at frame intersections, assure secure footing for the pump oiler.



A completely hard-faced dredge cutter. Blades, teeth or lips may be made self-sharpening by applying hard-facing on their front or inside face. This is the author's Fig. 14.

Analysis of fundamental factors

Hard-Facing Technique

★ Part 4—Factors which influence hardness of arc welded overlays—Heavier currents give greater penetration and a softer deposit due to admixture of base metal

By T. B. JEFFERSON

Engineer, Marine Design Section, Chief of Engineers, War Department, Washington, D. C.

IT WAS SHOWN in Part 3* that the hardness of a hard-facing deposit was increased as the length of the acetylene cone in the oxy-acetylene flame was increased. This action led to speculation as to whether changes in the amperage of the welding current when depositing hard-facing by the metallic arc process would likewise affect the hardness of the deposit.

Through a series of tests it was determined that the welding current had a definite effect upon the ultimate hardness of a hard-facing deposit. The test was begun by depositing a 3/16-in. heavily-coated hard-facing electrode on a standard base metal block using 150 amp. Two sets of specimens were made; one set consisting of single bead deposits, while the other set was made up of double bead deposits. Additional single and double bead specimens were made at 25 amp. intervals up to and including a welding current of 300 amp. The series was disconnected at 300 amp. as this current is considerable above that recommended for a 3/16-in. electrode.

The hardest deposits were obtained at the lowest current (150 amp.). These deposits were uniformly hard and free of imperfections. As the welding current was increased the porosity, slag inclusion, and other imperfections of welding were increased, while the hardness of the deposits indicated a tendency to decrease. Figure 12 portrays the manner in which the hardness of a hard-facing deposit decreases as the welding current is increased. It will be noted that from 150 to 250 amp. the decrease in hardness was approximately a straight line curve. Through this current range the Brinell number decreased an average of 1.54 points for every ampere increase in current.

The decrease in hardness may be attributed to the greater penetration which is obtained by using higher welding currents. The deeper the pen-

*Part 3 was published in February, 1940, issue, pages 27 to 29.

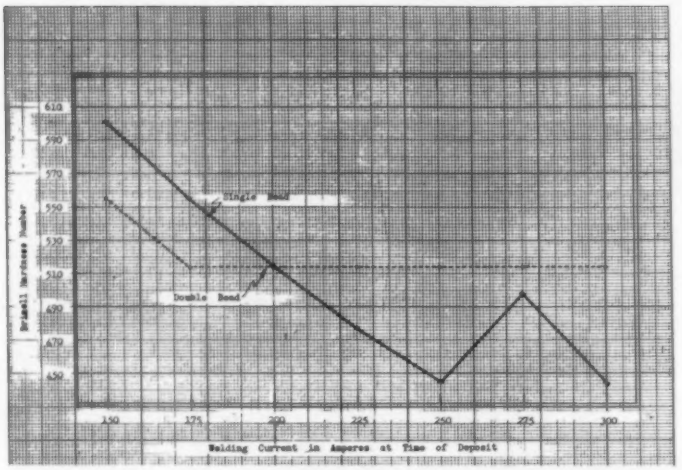


Fig. 12—Relationship between welding current and Brinell hardness of deposit, for both single and double beads.

Fig. 13 — Applying a protective coating of hard-facing, by means of the electric arc, to a dredge pump impellor.

etration the more likely the tendency of the base metal and hard-facing overlay to become mixed. Such a mixture naturally produces a softer deposit. The porosity and slag inclusion were the natural results of too high a melting rate and too fast a rate of deposition.

While the deposits made using a welding current of 150 amp. were the hardest, the slowness of the rate of deposition would probably be objectionable in continued hard-facing operations. Those deposits made at 200 amp. appeared to be placed at more nearly the correct speed for the 3/16-in. rods used in these tests. However, at that current the deposit began to exhibit porosity as well as a decrease in hardness. As the welding current was increased from 200 amp., the porosity and splatter loss increased very rapidly, while the hardness of the deposit decreased equally as fast. The hardness of deposits made at 275 amp. were erratic in that the hardness of these deposits tested considerably harder than those obtained at any current above 225 amp. This peculiar behavior in the hardness of hard-facing material deposited at 275 amp. appeared to be consistent and for that reason is unexplainable. At 300 amp. nearly 50% of the electrode used was lost through splatter. Also the electrode was melted so rapidly it was very difficult to control the deposit.

Double-bead deposits made at currents above 175 amp. were apparently unaffected by the amount of current used. These deposits were 41 Brinell points softer than the double-bead deposits made at 150 amp. As shown in Fig. 12 all of the double-bead deposits made above 200 amp. were harder than single-bead hard-facing deposits made at similar welding currents.

The arc process of welding in the deposition of hard-facing materials is rapidly finding favor despite the apparent disadvantages of this method. One objectionable feature is its high operating temperature, with greater penetration and resultant softer hard-facing deposit, because of dilution of overlay by the base metal. Another disadvantage with the use of the arc process is the high loss of hard-facing material due to flux coating and splatter.

These apparent disadvantages are offset somewhat by the faster rate of deposition and the lower concentration of heat resulting from use of the electric arc process. Since only that area directly beneath the arc is heated to a fusion temperature and the remaining surface of the base metal is comparatively cool there is less likelihood of warpage. This is particularly true when hard-facing heavy castings.

In the dredging industry, an industry using many steel castings which are subjected to abrasive, erosive and corrosive wear, hard-facing is used quite effectively to retard the effects of these destructive agents causing wear. Since most of these castings have thick sections the electric arc process is used almost exclusively for depositing the hard-facing overlay. In Fig. 13 is pictured a welder applying a protective

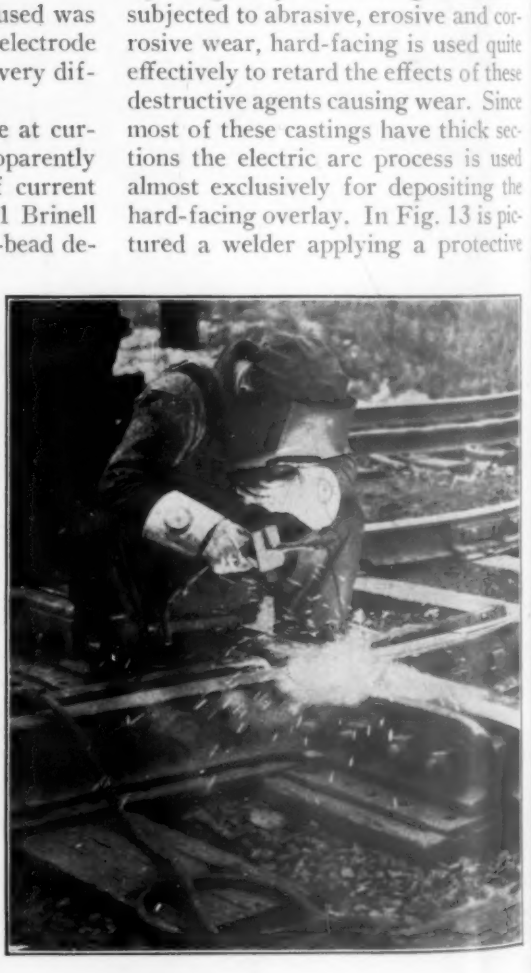


Fig. 15—Arc welding is generally favored in depositing a manganese-nickel overlay on manganese trackwork.

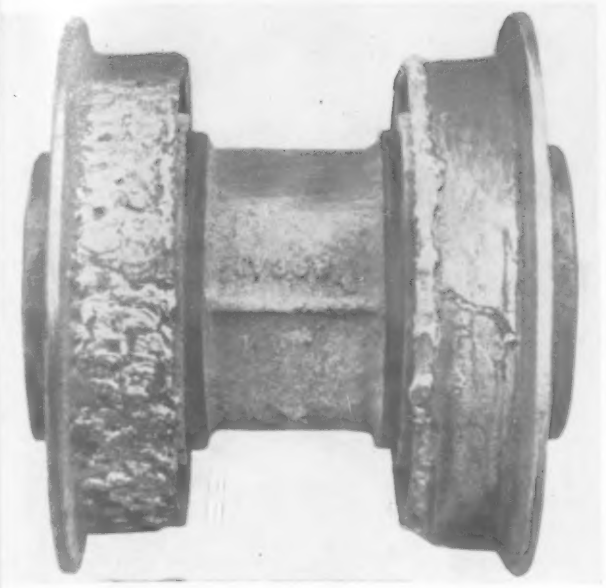


Fig. 16 — On this track roller of a crawler type tractor, a guide bead is first deposited around the inner edge of the tire.

coating of hard-facing to a dredge pump impellor.

The hard-facing of this four-ton casting is comparatively simple and quite effective if proper technique is used. It should be remembered in the hard-facing of an impellor, or any part subjected to severe erosive wear, that the protective overlay should be deposited at right angles to the direction of flow of the material causing erosion. rather than parallel to the flow. Beads deposited crosswise, while producing a "wash board" effect, tend to resist the erosive action of material flowing at high velocities. Beads deposited parallel to the flow sometimes wear very rapidly because of deposition defects occurring at the junction of the beads, i.e., due to the failure of the welder to properly fuse adjacent hard-facing beads. The effectiveness of hard-facing on dredge impellers is indicated by the fact that hard-faced impellers have been used for pumping as much as 22,000,000 cubic yards of material before being discarded. Naturally, during this period the impeller received many applications of hard-facing, but even so the cost per million yards of pumping was less than 50% of that of the unprotected impeller.

In Fig. 14 is shown a completely hard-faced dredge cutter. The hard-facing of a cutter blade, and the lip and teeth of excavating equipment involves much the same problem. The method of application must be varied according to the type of material to be excavated. If the equipment is to work in compact abrasive material, the hard-facing should be applied in such a manner as to assist in keeping these wearing parts sharp until they become so bardly worn that their replacement is necessary. The blades, teeth or lips may be made self-sharpening by applying the hard-facing on their front or inside face. This operation allows the base metal on the back face of these parts to wear away more rapidly than the front face, thus keeping sharp the parts so treated.

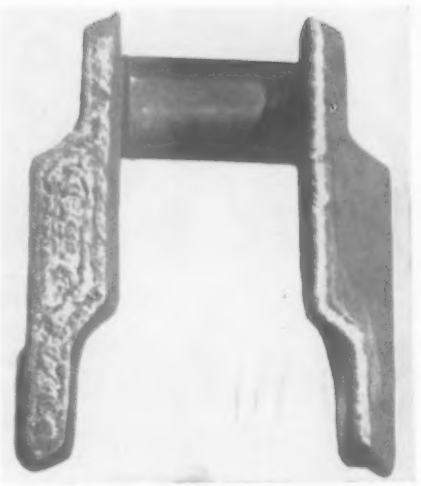


Fig. 17—How a guide bead is used in hard-facing a track link of a crawler type tractor.

Should the deposit be applied in a reverse manner, i.e., on the back face, the cutting edge would quickly become blunt and as the hard-facing was undercut would, after only a short working period, become useless as a cutting tool. When the equipment is to work in a loose abrasive material such as sand and gravel, the hard-facing should be applied as shown in Fig. 14, i.e., on the front and back faces as well as along the cutting edge of the blade. This will make the part blunt, but highly abrasion resistant.

Manganese Trackwork

Railroad crossings, switch points and frogs are also hard-faced extensively. Here again the electric arc process is used because of its tendency to lessen the amount of heating of the base metal during the deposition of overlay. Since most track castings are high manganese steel this is a very important consideration, because of the detrimental effect of excessive heat upon manganese steel. A welder is shown applying manganese-nickel-hard-facing overlay on a manganese crossing in Fig. 15.

The hard-facing of the track roller of the crawler type tractor as shown in Fig. 16 involves two steps: First, a guide bead of proper height is deposited around the inner edge of the tire. The tire is then rebuilt to its original height by depositing hard-facing between the guide bead and the flange. A guide bead is also used in controlling the height of the hard-facing deposit in the rebuilding of the track links or "rails" of a crawler type tractor as shown in Fig. 17.

A point to be remembered in these two operations is that the rollers do much more work than the rails. When the tractor is in operation the rollers are in constant contact with the rails, while an individual rail "link" is in contact with a roller only about one-third of the time. In view of this it may be seen that if the same type of hard-facing metal is deposited on both the rollers and rails, the rollers will wear much faster. To prevent this the rollers should be protected with a martensitic type of deposit, using an austenitic type on the rails.

(Continued on page 38)

TABLE 5—Effects of Welding Current Upon Hardness of Welded Overlays

SINGLE BEAD DEPOSITS			DOUBLE-BEAD DEPOSITS		
Specimens	Welding Current	Brinell Number	Specimens	Welding Current	Brinell Number
Average (5)	150 amp.	601	Average (3)	150 amp.	555
Average (5)	175 amp.	555	Average (3)	175 amp.	514
Average (5)	200 amp.	515	Average (4)	200 amp.	514
Average (7)	225 amp.	477	Average (4)	225 amp.	514
Average (3)	250 amp.	445	Average (3)	250 amp.	514
Average (4)	275 amp.	498	Average (4)	275 amp.	514
Average (4)	300 amp.	444	Average (3)	300 amp.	514

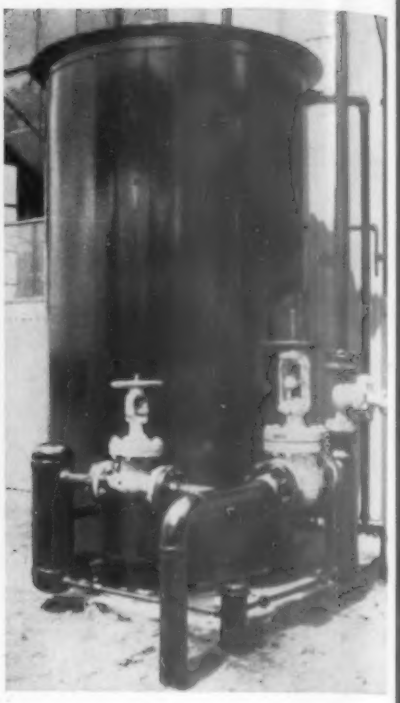


Fig. 1—This simple heat exchanger is employed for cooling compressed air.

Design problems in building a

Welded Heat Exchanger

★ Compressed air is essential in recovery of sulphur—High-pressure air must be cooled before and after stepping up pressure from 500 psi. to 1000 psi.—Simple arc welded design permitted substantial saving in cost

By J. H. POLLARD*

Chief Engineer, Duval Texas Sulphur Co., Houston, Texas

IN THE MINING OF sulphur as practiced in the Texas-Louisiana Gulf Coastal area, compressed air plays a very important role. The Frasch process of sulphur mining, so named after its colorful inventor and developer, the late Hermann Frasch, consists essentially of melting the sulphur in place and pumping it to the surface of the ground. As the formations from which sulphur is mined in the Gulf Coastal deposits are generally from 400 to 2000 ft. below the surface, and since molten sulphur is corrosive, twice as heavy as water, and must be kept at a temperature of about 300 deg. F., numerous difficulties beset any attempt to pump the sulphur by mechanical means.

There are, however, no prohibitive hazards in the application of an air lift to this pumping problem. Hence, it is standard practice in all Frasch process sulphur mines to pump liquid sulphur from underground formations, much as water is pumped with an air lift. For this service pressures ranging from 300 lb. to 1000 lb. gauge are used.

During the construction in Texas of a new sulphur producing plant, it was decided advisable to provide a means of supplying air at either 500 or 1000 lb. gauge as desired. A battery of three large 12 in. x 13 in. x 6 in. x 14 in. duplex steam-driven two-stage compressors were provided for supplying the 500-lb. air. For the 1000-lb. air a small 12 in. x 4½ in. x 10 in. single-tandem steam-driven machine was installed taking suction from the 500-lb. discharge header from the big machines. At full load, delivery of the three low-pressure machines is slightly over 1100 c.f.m. of free air compressed to 500 lb. gauge. The small machine taking suction at 500 lb. will deliver 985 c.f.m. of free air compressed to 1000 lb.

The air cylinders on all machines are of course water jacketed and the low-pressure machines are provided with conventional inter-coolers between the

(Continued on page 39)

*The author's paper was one of the winners in the $200,000 Award Program of the James F. Lincoln Arc Welding Foundation.

Three-day meeting of I.A.A. will be held at Hotel Schroeder, Milwaukee, Wis., April 10th to 12th.

A well organized program is planned for

Annual I. A. A. Meeting

LATEST PRACTICES and developments in various applications of the oxy-acetylene process in American industry will be the major theme of discussion at the forthcoming annual convention of the International Acetylene Association to be held April 10, 11 and 12 in Milwaukee, Wis., at Hotel Schroeder. Well-known engineers and technical experts in the oxy-acetylene industry have been selected to present a series of comprehensive papers of interest to operators of welding and cutting equipment, shop foreman, plant superintendents, operating and designing engineers, and executives. The daily and evening sessions of the convention will be open to anyone wishing to attend. There is no registration fee.

The program has been organized so that the subjects discussed and the ideas presented in the technical papers will appeal to the greatest number of people. Informal round-table meetings, and a panel discussion on oxy-acetylene machine-cutting have been arranged to provide an opportunity for a discussion of individual problems with the welding and cutting experts and for "listening in" on a discussion of one of today's most useful applications of the oxy-acetylene process. To provide time for the increased number of papers on the wide variety of subjects to be presented, two technical sessions are scheduled to be held simultaneously on Wednesday and Friday afternoons at the Schroeder Hotel.

On Wednesday afternoon, April 10, papers will be presented at the first of these simultaneous sessions on welding of carbon-molybdenum pipe, welding industrial piping, and developments in silver-soldering. A fourth paper will discuss the layout and management of a modern welding shop. The second technical session on Wednesday will be devoted to the general subject of reclamation, repair and maintenance, and will include papers on the use of the oxy-acetylene process for repair work in shipyards, foundries, steel mills, railroad shops and on the farm.

Round-table discussions, so popular at two previous I.A.A. conventions, will be held again this year on Wednesday evening at the Milwaukee Vocational School. After a short forum-demonstration meeting in the auditorium, the audience will adjourn into small groups to discuss such subjects as flame-treating, hard-facing, machine cutting, welding alloy steels, air-acetylene applications, pipe welding, riser cutting, welding non-ferrous metals, and other subjects. Each group will have a leader who is qualified as an expert in the particular phase of the oxy-acetylene process assigned to that

group for discussion. These evening meetings will be of interest to everyone concerned with the use of the oxy-acetylene process, but will be particularly important to superintendents, foremen, master mechanics, and welding and cutting operators.

The panel discussion on oxy-acetylene machine-cutting is scheduled for Thursday afternoon, April 11, in the Crystal Ball Room of the Schroeder Hotel. The subject will be thoroughly discussed by a group of prominent engineers representing both manufacturers and users of machine-cutting equipment.

The convention will close with two simultaneous technical sessions on Friday afternoon, April 12. Foundry and heavy industry applications of the oxy-acetylene process will be under consideration at one session, with papers on such topics as flame-cleaning, dehydrating and descaling, scarfing and gouging, heavy cutting and applications of the oxygen lance, and efficiency control in oxy-acetylene cutting. The broad subject of fabrication and production has been scheduled for the second technical session. This session will be concluded with papers on the welding and brazing of light-gauge metal, including stainless steel; design and construction of jigs and fixtures for sheet metal welding; welding for enameling; and automatic bronze-welding.

Following is an outline of the tentative I.A.A. technical program:

Tentative Program of I.A.A. Meeting

WEDNESDAY—APRIL 10

Opening Session—Luncheon 12:15 P.M., Crystal Ball Room, Schroeder Hotel.

Chairman—**H. P. Dolisie,** president, International Acetylene Association.

Vice-Chairman—**Henry Booth,** vice-president and treasurer, International Acetylene Association.

The opening session luncheon will be followed by an address of welcome, a keynote speaker, the president's address, presentation of the Morehead Medal and its acceptance by the honored recipient.

Two Simultaneous Technical Sessions

Technical Session A—Pere Marquette Room, Schroeder Hotel—2:30 P.M.

Subject—"General Applications of Oxy-Acetylene Process."

Chairman—**K. L. Hansen,** Harnischfeger Corp., Milwaukee, Wis.

Vice-Chairman—**J. I. Banash,** consulting engineer, International Acetylene Association, Chicago.

"Layout and Management of a Modern Welding Shop."

(Speaker to be announced.)

"Welding of Carbon-Molybdenum Pipe for High-Temperature and High-Pressure Service."

Part 1—Laboratory Development by **R. M. Rooke** and **S. C. Saake,** Apparatus Research and Development Dept., Air Reduction Sales Co., New York City.

Part 2—Field Testing and Application by **A. N. Kugler,** mechanical engineer, Applied Engineering Dept., Air Reduction Sales Co., New York City.

"Latest Practices in Welding Industrial Piping."

(Speaker to be announced.)

"Low-Temperature Brazing with Silver Alloys—R. H. Leach, vice-president, Handy & Harman, Bridgeport, Conn.

Technical Session B—Green Room, Schroeder Hotel—2:30 P.M.

Subject—"Reclamation, Repair and Maintenance."

Chairman—**R. C. Woodward,** Bucyrus-Erie Co., Milwaukee, Wis.

Vice-Chairman—**E. L. Mills,** vice-president, Bastian-Blessing Co., Chicago.

"Cutting in Shipbuilding and Repair"—Robert E. King, engineer, Manitowoc Shipbuilding Corp., Manitowoc, Wis.

"Welding in Maintenance of Foundry and Steel Mill Equipment."

(Speaker to be announced.)

"Railroad Welding Practices"—G. M. Magee, research engineer, Engineering Division, Assn. of American Railroads, Chicago.

"Maintenance of Agricultural Equipment"—D. K. Struthers, extension agricultural engineer, Iowa State College, Ames, Iowa.

Night Session—8:15 P.M.

Round Table Discussions.

Milwaukee Vocational School Auditorium, North Sixth and West State St., Milwaukee, Wis.

Honorary Chairman—**Otto Voss,** Allis-Chalmers Corp., Milwaukee, Wis.

General Chairman—**G. T. Horton,** president, American Welding Society.

Vice-Chairman—**J. J. Crowe,** Air Reduction Co.

Narrator—**W. B. Browning,** Linde Air Products Co.

Demonstrations:

1. Multi-Flame Pipe Welding.
2. Flame-Cleaning.
3. Plate Edge Preparation.
4. Wrinkle Bending.
5. Flame-Descaling and Dehydrating.
6. Machine Flame-Cutting.
7. Heating for Bending and Straightening.

Subjects for Round Table Discussions:

1. Flame-Hardening.
2. Machine-Cutting.
3. Repair and Maintenance.
4. Non-Ferrous Metals.
5. Alloy Steels.
6. Riser Cutting, Flame - Cleaning, Gouging and Use of Oxygen Lance.
7. Sheet Metal (including Jigs).
8. Low Temperature Brazing and Soldering and Air Acetylene Applications.
9. Hard-Facing.
10. Safety and Fire Prevention.
11. Testing of Welds.
12. Pipe Welding.
13. Heating for Straightening and Bending.

THURSDAY—APRIL 11

Annual Luncheon, 12:15 P.M.—Crystal Ball Room, Schroeder Hotel.

Chairman—**H. P. Dolisie,** president, International Acetylene Association.

Vice-Chairman—**H. S. Smith,** chairman, Executive Committee, International Acetylene Association.

Short reports of committees, secretary-treasurer and consulting engineer.

Address: "Health Aspects of Oxy-Acetylene Process."

Dr. A. G. Cranch, industrial toxicologist, New York City.

Discussion:

A. G. Kammer, medical director, Inland Steel Co., Chicago.

O. G. Sander, Milwaukee, Wis.

Eugene L. Walsh, Northwestern University Medical School, Chicago.

Panel Discussion—Crystal Ball Room, Schroeder Hotel, 2:30 P.M.

Lecture—"Machine Flame - Cutting"—This lecture will be presented by **Harry C. Boardman,** research engineer, Chicago Bridge & Iron Co., and past president, American Welding Society. There will be a panel discussion following the lecture.

Chairman—**J. H. Zimmerman,** development manager, Linde Air Products Co., formerly associate professor, Massachusetts Institute of Technology.

FRIDAY—APRIL 12

Two Simultaneous Technical Sessions

Technical Session A—Green Room, Schroeder Hotel—2:00 P.M.

Subject—"Foundry and Heavy Industry Applications of Oxy-Acetylene Process."

Chairman—**Eugene A. Balsley,** welding engineer, Link-Belt Co., Chicago, and chairman Chicago section, American Welding Society.

Vice - Chairman—**Lorn Campbell,** Jr., president, Harris Calorific Co., Cleveland, Ohio.

"Efficiency Control in Oxy-Acetylene Cutting"—E. K. Carlson, superintendent, Chicago Bridge & Iron Co., Chicago.

(Continued on page 48)

Fig. 1—Cutting a V groove in ¾ in. plate to prepare it for welding. The plate is supported on a planer bed and moves past the stationary blowpipe. Photo (Linde Air Products Co.).

Speed and economy are features of the

Flame-Gouging Process

★ Process was used originally to "gouge" out backside of welds on butt joints—Its economic advantages are gaining recognition in many industrial operations

IN THE FLAME-GOUGING process, using special oxy-acetylene equipment, it is possible to perform a wide variety of cutting operations in a small space of time. The gouging blowpipe is somewhat analagous to the familiar woodworker's chisel. As originally developed, the process was used to remove metal from the underside of heavy butt welds in steel plate. It was also used to remove weld defects as might be revealed by x-ray inspection, magnetic flux inspection, or by eye inspection. In this respect, the flame-gouging process has displaced the familiar pneumatic hammer. The process then came into more extended use for industrial maintenance operations. Recently this type of equipment is being used for preparation of plate edges for welding.

Flame-gouging results in quick removal of a narrow strip of surface metal from steel plate, forgings or castings. This is similar to what is done in conditioning steel when defects are removed by the oxy-acetylene deseaming blowpipe. If a nozzle designed to deliver a relatively large jet of oxygen at low velocity is properly manipulated, a smooth, accurately-defined groove can be cut or gouged out of the surface of the metal. By using different nozzles and manipulations, the groove can be varied in width and depth at the will of the operator.

Once this principle is understood, many uses for the process will suggest themselves. These can be classified conveniently in five groups: (1) gouging backside of electric welds; (2) removal of weld metal, such as temporary tack-welds and defective welds; (3) maintenance and scrapping operations; (4) plate-edge preparation; and (5) miscellaneous uses.

Backside of Arc Welds

In the fabrication of steel vessels, tanks and other welded structures, the foot of the initial weld is usually removed, so that clean metal is assured when the back weld is made. This is one of the applications for which the gouging blowpipe was originally designed, and many tests show that the process is not only much faster, but also considerably more economical than other methods of weld removal. In the fabrication of a tank only 20 min. was required to gouge the backside of 25 linear ft. of welded seam, including 12 ft. of longitudinal weld and 13 ft. of circumferential weld. Other methods on this same job formerly required at least 3½ hr.

Figure 2 (A) shows the conventional U-groove preparation in weld design. The section enclosed by dotted lines is removed by gouging, brushed free of slag, and then electric welded. The usual double-vee preparation is indicated by Fig. 2 (B). Here, the same procedure is followed as in 2 (A), the only difference being in type of weld design. Fig. 2 (C) shows a third method of U-grooving when a backing-up strip has been used to aid penetration in the initial weld. In this application of gouging, the operation consists of first removing the center of the backing-up strip without cutting into the base metal, then parting the small tack-welds that

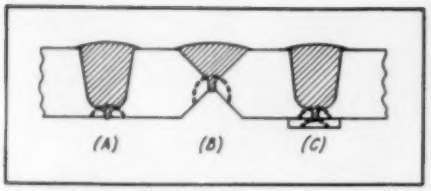
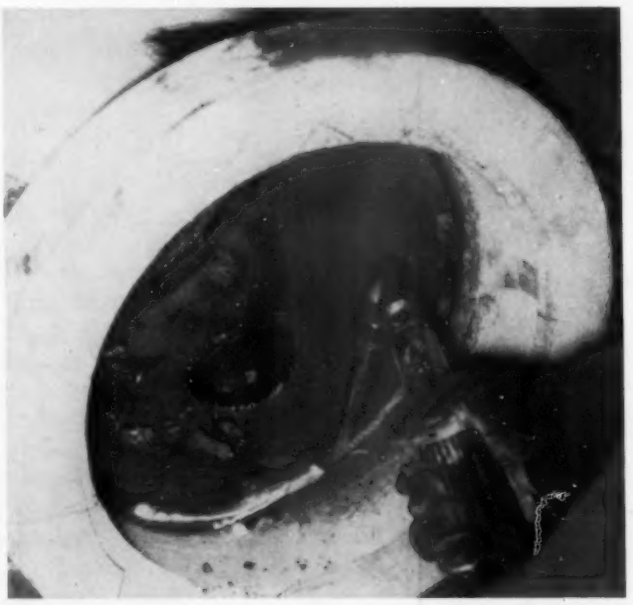


Fig. 2—Conventional butt welds, the dotted lines show metal which can be removed by gouging. (A) Single V groove. (B) Double V groove. (C) Single V groove with backing-up strip.

hold the strip to the plate. When this has been done, the metal contained within the second dotted line is removed by a second pass of the gouging blowpipe.

An application of gouging is illustrated in Fig. 3. Here, the operator is removing the initial weld from the inside diameter of a large flanged pipe which is being fabricated as part of oil refinery equipment. After the pipe and flange have been joined by the initial layer of weld metal (a tack-weld), a second layer is deposited on the outside diameter of the pipe. Then the first layer is largely removed by gouging and the pipe rewelded on the inside.

Fig. 3—Initial tack-welding is being removed quickly from inside of this pipe section by flame-gouging. Photo (Linde Air Products Co.).



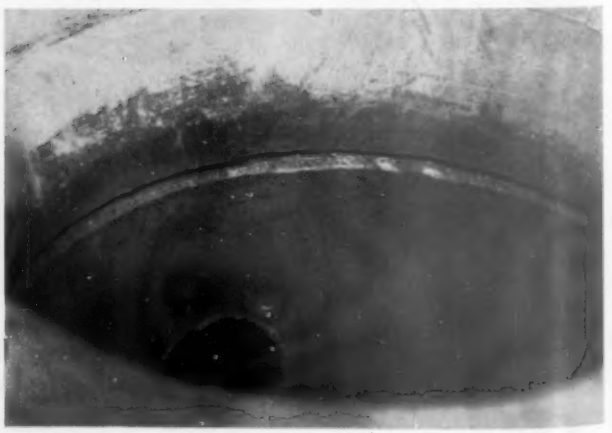
Removing Temporary Welds

In many types of fabricating work, temporary tack-welds are used to hold plates, lining-up bolts, or lining-up tabs in position. Upon completion of welding, these temporary supporting tabs, brackets, or bolts must be removed. General practice has been to remove these sections by chipping. Here again, gouging has proved to be faster and more economical.

A typical example is found in removal of studs welded to pipe for testing purposes. During the laying of a 48-in. pipeline, numerous special sections could be tested only by clamping a 2½-in. thick header to the ends of the sections, with the header held in place by 1½-in. diameter studs welded to the pipe. A gouging blowpipe was used to remove these studs after the pipe section had been tested. Only 2 min. was required to remove a stud as compared with the 21 min. formerly necessary.

Sometimes visual or x-ray examination of a welded section will disclose a defective zone of metal that must be removed. This can be done quickly by spot gouging. The resulting cut is a narrow U-shaped groove which can be readily filled with new weld metal. A minimum of metal is removed, making this a rapid and economical process. When a weld shows defects for any great distance, it can be removed in its entirety by gouging.

Fig. 4—A high degree of accuracy is possible in flame-gouging a welding groove on inside of pipe section. Photo (Linde Air Products Co.).



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TECHNICAL SESSIONS

Hotel Schroeder, Milwaukee, Wis.

The gouging operation prepares the section for rewelding.

Gouging is also valuable for relocating welds in welded construction. For instance, in the plant of a machinery manufacturer, a large excavator was ready for shipment when tests indicated that certain parts welded to the boom would have to be relocated. With the gouging blowpipe, the fillet weld that secured the parts was removed without injuring the main members of the boom. Since this excavator was already two days overdue, at a penalty of $100 a day, the speed of the gouging operation proved doubly valuable.

Maintenance Operations

When a piece of machinery breaks down, one of the most important factors in its repair is the time which elapses before it is back on the job. Welding has already been a vital factor in reducing shutdown time; now, gouging as a means of preparation for welding reduces the time still further. Cracks in large cast steel sections, heavy forgings, and thick plate can be grooved for welding in a matter of minutes by gouging. Gouging apparatus is particularly valuable in minutes, smelters, rolling mills, and, in fact, any plant where maintenance of heavy machinery is an important factor in production.

Fig. 5 — Cutting a U groove in circular plate by rotating the work on a turntable. Photo (Linde Air Products Co.).

In one plant, production was at a complete standstill when it was found necessary to remove a large pinion gear from the drive shaft of a 100 ton-per-day lime kiln. The gear was 15 in. in diameter and 18 in. long and had frozen to the shaft. After workmen had spent 6 hr. without success trying to remove the gear by pressing it off, the gouging blowpipe was employed and the job completed in 20 min. In this same plant, a 12-ft. diameter wheel was repaired by gouging in one-third the time which would have been required by any other method. Also, pulverizer hammers are now grooved out for welding in one-quarter the time it used to take.

Ability of the gouging blowpipe to cut to close tolerances without damaging the base metal is of great value in scrapping operations. Welded structures can be dismantled at high speed by gouging out the welds, and the plate thus salvaged can be prepared for re-use by oxy-acetylene machine-cutting.

Plate-Edge Preparation

One of the most recent applications of the gouging process is for preparation of plate edges for welding. Although a straight bevel is easily made in plate with a cutting blowpipe mounted on a cutting machine, whenever a U-groove is specified, the only alternative to gouging is the process of planing. With the development of the gouging process, however, metal fabricators now have at their command a method which will fulfill most of their requirements in preparing plate edges for welding.

Short lengths can easily be gouged by hand, while longer lengths can be gouged by mounting the blowpipe on a cutting machine, or by placing the work on a suitable traversing device, such as a planer bed. By varying the nozzle size and angle of blowpipe to the work, a variety of edge contours can be produced.

Figure 1 shows a typical mechanized setup for U-grooving the edge of ¾-in. plate. The plate is placed on a planer bed and lined up so that the edge to be prepared is parallel to the travel of the bed. The blowpipe is held by a special mounting and is stationary during the operation.

Circular Plate Edges

An arrangement for preparing the edges of circular plates is shown in Fig. 5. Here, the plate is placed on a turntable and rotated past the blowpipe. A remarkable true U-groove is the result. This plate is to be used to form part of a new coupling for a shaft, and, in final assembly, is welded to a flame-cut steel ring that fits about its outer circumference.

In preparing edges where the plates are either butted together or spaced apart, after the initial bead has been deposited, a portion is removed by gouging to form a clean U-groove for welding. The initial bead may or may not be removed later. Figure 6 shows a practical application of the U-grooving of butted plates. Here, working on the deck plates of the dredge, the operator is gouging a groove between two plates butted together. An excellent job can be made by hand in preparing joints of this type in plate up to ¾ in. thick.

It should be mentioned that the quality of the surface prepared for electric welding by gouging is high and that such a surface is not detrimental to the weld. X-ray examination of electric welds made in grooves cut by gouging have shown exceptionally clean welds.

The only special equipment required for gouging operations is a series of three nozzles (see Fig. 7) each designed differently as to size and number of preheat orifices and size of cutting oxygen orifice so as to cover a wide range of gouging speeds and groove dimensions. They are designated by the numbers 13, 19 and 25, which refer to the approximate diameter of cutting oxygen orifice in hundredths of an inch. These nozzles are for use with a standard medium-pressure cutting blowpipe.

Progressive Gouging

There are, in general, two different techniques for gouging: one in which a groove is made progressively across a plate, as in the removal of metal from the backside of welds; the other, known as spot-gouging, in which a small area is gouged out, as in the removal of isolated weld defects. In the first or progressive method, the correct nozzle is selected and oxygen and acetylene pressure regulated to give the desired width and depth of groove.

In starting the cut, the blowpipe is held with the end of the nozzle at an angle of approximately 20 deg. to the horizontal and above the line of the cut. The preheat flames are played on the spot where the cut is to be started until the surface reaches the ignition point. The cutting oxygen lever is then gradually depressed. The cut progresses slowly while the angle of the end of the gouging nozzle is gradually reduced to the correct operating angle. This angle, approximately 5 deg., will be readily discernible by the operator. If the nozzle is not lowered far enough, some of the slag will tend to flow backward in the cut towards the operator, while if the blowpipe is lowered too far, the groove will become shallow and will soon be lost.

In starting the gouge, the blowpipe is held so that the tips of the inner cones of the preheat flames are just touching the work. After the cut is started, however, the nozzle is held above the surface of the cut, with the tips of the inner cones from ¼ in. to ½ in. in back of the reaction zone. Best results are obtained when the blowpipe is held so that the nozzle clears the bottom of the groove.

When it is necessary to change the

Fig. 6—Using the gouging blowpipe to prepare deck plates for a single-groove butt weld. Photo (Linde Air ProductsCo.).

direction of the cut, the angle of the nozzle in relation to the work should remain unchanged, while the blowpipe is gradually swung around in the new direction. Too sharp turns should be avoided lest the outside wall of the groove be cut into by the molten slag. It is advisable to use lower operating pressures and speeds when not cutting in a straight line.

Contour of Groove

The depth of the groove depends upon size of the nozzle, speed of progress, and angle between cutting oxygen stream and work. To cut a deep groove, the angle of the blowpipe is increased in relation to the groove, and the speed is correspondingly decreased. In order to make a shallow groove, the procedure is reversed. With the establishment of the correct depth of cut, it is said to be an easy matter to maintain this depth throughout the full length of cut. Grooves can be made that are as deep or slightly deeper than they are wide.

The contour of groove is dependent upon characteristics of nozzle used and operating conditions. If cutting oxygen pressures are too low, the cutting takes on a washing effect, leaving ripples in the bottom of the groove. The effect of too high cutting oxygen pressures is to advance the portion of the cut nearest the surface ahead of the rest of the molten zone, with the result that the cut is finally lost.

Spot Gouging

In gouging out a single spot, such as a weld defect, the defect is first marked out on surface of the weld. Then the operator adjusts preheat flames of the blowpipe so that they are slightly oxidizing. A point is selected a little to the rear of the mark, depending upon how deep the defect is believed to be. The cut is started in the usual manner by preheating the spot, but instead of reducing the angle of the nozzle, it is increased gradually so that the oxygen jet is directed downwards, making the cut increasingly deep. As in deseaming, a little experience enables the operator to observe readily any defects which appear as dark spots in the molten zone.

The blowpipe should be held so that the inner cones of the preheat flames are approximately 1/16 in. above the plate surface at all times during the cut. The use of oxidizing preheat flames provides a sufficient amount of concentrated heat for starting cuts on the surface of the weld metal, thus doing away with the necessity of first raising a fin with a chisel. The nature of the resulting cut is a narrow U-shaped groove which can readily be filled with weld metal.

Among the steels allowable under sections S-1, S-2 and S-26 of the A.S.M.E. Boiler Construction Code, which cover specifications for plate used for boilers and pressure vessels, are high tensile strength carbon steel plates 2 in. and under in thickness and having a maximum carbon content of 0.35%. The code is similar to the A.S.T.M. and A.P.I. codes covering like material. Steels of this type, having a carbon content of 0.35% and under, can be processed with the gouging blowpipe with excellent results.

As a general rule, gouging should not be applied to air-hardening steels where the hardness resulting from the operation will be objectionable. For example, clips should not be removed from the surface of a vessel where the carbon content of the plate is so high as to cause the formation of a hardened zone having decreased ductility.

Care should be used in gouging alloy steels. Test cuts should first be made in scrap, and the operator should determine from these cuts whether the characteristics of the metal adjacent to the cut have been changed too drastically.

As already mentioned, good results are obtained on cast steels if proper techniques are followed. Cast-iron, however, cannot be gouged.

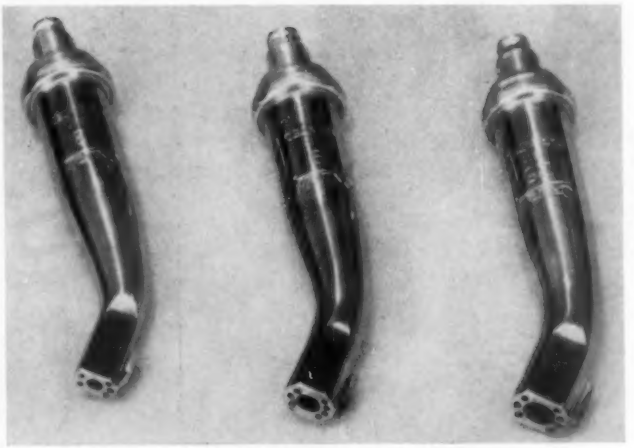

Fig. 7—Three specially-designed nozzles for flame-gouging. Photo (Linde Air Products Co.).

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Hotel Schroeder, Milwaukee, Wis.

Fig. 1—Operator is using flat multi-flame oxy-acetylene tips mounted on hard-faced skids to surface condition web plates of a fabricated steel girder. Photo (Airco).

Recent apparatus developments for

Surface Flame-Conditioning

★ Descaling, cleaning and dehydrating of steel surfaces can be done economically by the oxy-acetylene flame—Effective also in removing old paint

By JOSEPH G. MAGRATH
Engineer, Air Reduction Sales Co., New York City

IT IS WELL RECOGNIZED that high-temperature scale on steel billets in the steel mill prevents close inspection of surfaces for minute defects and fine seams prior to flame-scarfing or chipping. In flame-descaling billets, slabs, rounds, bar-stock, blooms and ingots in the steel mill, the process employs the use of the oxy-acetylene torch in combination with brush-type tips, on extensions, which are positioned so that the enveloping flame completely covers the scaled surface for the width or expanse of the tip flames. These tips are mounted on wheeled carriages or hard-faced skids and are traversed over the surface at the proper rate of speed to remove the maximum amount of scale. This speed will range from 10 to 20 ft. per min.

By means of the high temperature thus applied the scale is rapidly heated without overheating the base metal. A differential expansion results, causing the scale to lift, crack and fly off in particles ranging from 1/16 to ¼ in. cross dimension on billets, bars, rounds and slabs and from ⅛ to 1 in. cross dimension on forgings and steel castings.

While the flame-descaling process has not been developed to the stage providing for complete scale removal on all grades of higher alloy steels, it is found to serve satisfactorily for the greater volume of common grades of carbon and low alloys. In this service it reduces the tonnage passing through the pickle and thus the amount of pickle waste ultimately to be disposed of. The process may also be used to supplement the pickling operation in that the greater amount of loose scale may be flame descaled and the remaining lesser amount removed in a brief pickle with acid of reduced strength.

Flame-descaling leaves a natural surface. Artificial resurfacing found in various other scale-removing procedures is absent. A surface is disclosed which, to the untrained eye, is not recognized at first long range glance as being a "clean" surface. Close examination, however, will disclose that when the scale has been removed by flame-scaling, the true unaltered surface of the metal is exposed. There

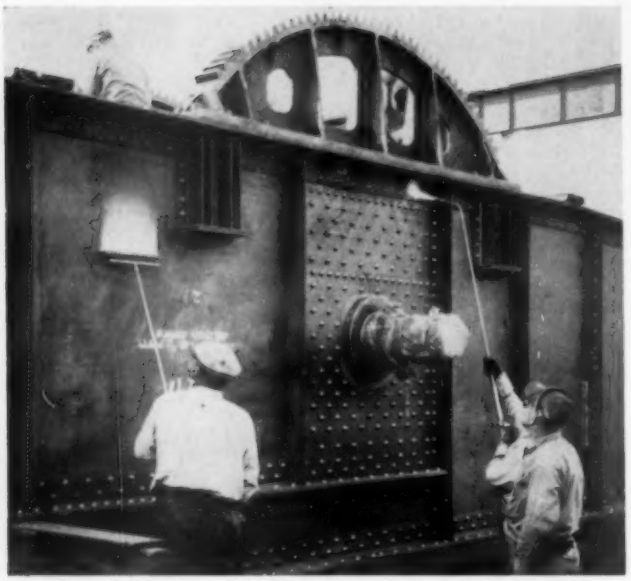

Fig. 2 — Operators are using flat mutli-flame tips on web plates and round multi-flame tip on rivet heads and irregular surfaces. Photo (Airco).

is no chemical or physical action upon, or discoloring of, the base metal. The process is rapid and is one that can be fitted into a production line.

Foundry or Forge Shop

Where the flame-descaling process is employed in the foundry or forge shop, it offers numerous advantages. A natural surface is secured, as there is no graining, indentation or chisel marking. Defects, seams and fissures are exposed. The process is comparatively quiet and is safe in that there is very little dust and it flies no considerable distance. It may be conducted in areas adjacent to other plant operations thereby eliminating handling or re-handling costs. Size of object is not a limitation. Castings weighing from 1 lb. to 100 tons or more may be flame-descaled. The flames will reach remote crevices and deep openings as the apparatus is very flexible. There is no chemical or physical action upon, or discoloration of the base metal, and where painting follows on castings or forgings, the beneficial action of surface dehydration is obtained.

On steel castings and forgings, the oxy-acetylene flame-descaling process rapidly heats the scale without materially heating the base metal and causing internal stesses to develop. While scale on steel castings will generally free itself in particles of 1/64 to ⅛ in. thickness, and from ⅛ to 1 in. in cross dimension, forging scale may range to 3/16 in. in thickness and break free in particles of ¼ to ½ in. in cross dimension. Steel casting scale will as a rule free itself completely down to the scale-steel interface with one pass of the flames, whereas forging scale may break free in two or more layers, requiring a second pass of the flames after the surface has sufficiently cooled from the first pass.

A round tip is generally accepted as a universal tip for forgings and steel castings. Its double circular group of neutral clear-cone flames provides a large volume of concentrated heat. It may be used on flat or irregular surfaces and for projections, corners and remote recesses. Ordinarily the tip is held in a vertical or near-vertical position about 2 in. from the work, swinging sideways right and left for a spread of about 12 in. and progressively moved in a forward direction. Some of the very tenacious scales may require that the tip be held closer to or against the work at an angle of about 45 deg. -A hard-faced annular protective and wearing ring is provided on the tip for this purpose.

Where very large steel castings provide large flat areas, an opportunity is presented to use a broad flat multi-flame tip to advantage. This style is available in widths ranging from 2 to 12 in. in 2-in. increments and consists of a row of close formation small brush-like flames. Tips are mounted on renewable steel hardfaced wearing skids, and are guided across the surface at a forward speed of 5 to 10 linear ft. per min., and at a flame impingement angle of approximately 45 deg.

Structural Steel

On structural steel, the loosening and flaking off of mill scale, taking the paint with it, has been the cause of considerable discussion between fabricators of structural steel and manufacturers of paint. Where such conditions occur, the steel is fully exposed to atmospheric oxidation prior to finish-painting and opportunity is provided for moisture to find its way between the remaining scale and steel, remaining after finish-painting, and continuing its destructive action so that frequently within a year or so, inspection shows large areas of exposed steel, atmospherically oxidized. Heavy maintenance costs are the result.

The oxy-acetylene flame-cutting and dehydrating process provides a smooth natural surface. The application is simple and safe, and the health hazard angle being absent, as there is very little dust. At the present time, this process is pronounced preferable by many engineering authorities in the fabrication field. It is felt by many to be superior to methods heretofore employed and a number of engineers and fabricators are making use of the process. Adherence to the recommended procedure is compulsory if satisfactory results are to be expected and, as a guide, specifications are available to

Fig. 3—Flame-descaling steel billets, using flat multi-flame tips supported on hard-faced steel skids. Photo (Airco).

users of the process, as well as to those interested in entering such in their specifications. Cost estimating data are available based on tonnage and square footage for any particular classification of structure. As the square footage of surface per ton of steel will vary considerably due to the difference in structural shape, dimension and weight, a uniformly average cost per ton price for the process application is not readily obtainable.

Flat tips mounted on renewable steel hard-faced wearing skids, provide a row of close formation small brush-like flames which are guided across the surface at a forward speed of 10 to 20 ft. per min., and at a flame impingement angle of approximately 45 deg. Widths of tips range from 2 to 12 in. These are used generally on flat surfaces. Round tips having hard-faced annular wearing rings are more efficient for cleaning of rivet heads, fittings, faying surfaces, corners and other projections inaccessible to the broad flat tips. Rivet heads particularly carry a heavy scale.

Differential Expansion

As the flames progress along the surface, due to the differential expansion between the scale and the base metal, a variable amount of the mill scale is loosened and cracked off. This scale-lift may, in a measure, be also attributed to the conversion of the occluded moisture within and beneath the scale, to steam, with the resultant explosion blowing the scale clear of the steel surface. The fully loosened scale flies in a shower of small flakes and minute particles which rapidly fall earthward. There is no dust hazard. A further amount is partially loosened to such degree that it is easily broken free by the light wire-brushing which immediately follows.

Fig. 5—Section of a reconditioned bridge truss after paint burning and surface - conditioning. Fabricated in 1907, this structure almost appears as good as new. Photo (Airco).

The flames remove surface impurities other than oil and grease, which, as is customary, are removed (degreased) beforehand with mineral spirits, benzine or gasoline. Sufficient heat is imparted to the steel to raise its surface temperature to a point above 212 deg. F. (but below 300 deg. F.) driving off all moisture. However, the temperature is not raised sufficiently to create a condition injurious to the steel. Sufficient heat remains in the steel for an extended period to allow for painting before recondensation of moisture occurs on the surface of the steel.

The process provides its own regulation and inspection. The operator self-regulates his speed, in that if he moves too fast he will not lift sufficient scale, and if he moves too slowly, the surface will be slightly fused but not to an injurious extent. Therefore, he automatically accustoms himself to the proper speed for the removal of the maximum amount of the scale that will loosen. This amount is dependent upon the age of the steel members and to what extent they have been exposed to atmospheric change.

Steel, fresh from the rolling mill and with little or no weather exposure will seldom provide greater than a 10 to 15% scale-lift, whereas aged steel, exposed for several months to atmospheric change, may provide for a scale-lift of 50 to 60%. That scale which will not lift either with the flame or the wire-brushing that follows, is passed on inspection as definitely tight scale which there is no point in removing, provided the moisture is driven therefrom.

Paint Burning

Recent experiments with the oxy-acetylene flame cleaning and dehydrating process for the paint-burning and surface-conditioning of old painted steel structures have met with encouraging success. Early ineffectual methods of surface cleaning, or none whatever in most cases, followed by the resulting lift of loose mill scale and the eventual loss of paint, have resulted in heavy expenditures on steel bridge surface mentenance. We need not go far to view structures erected a few years past on which large areas are free of paint and are heavily atmosperically oxidized.

Spot painting of these areas has not solved the problem to full satisfaction. A number of bridge engineers have arrived at the conclusion that the only satisfactory solution is the removal of the old paint either down to the base paint coat or, where possible, down to the steel, then properly condition the base surface and repaint. All loose mill scale and rust must be fully removed, the "open sores" thoroughly

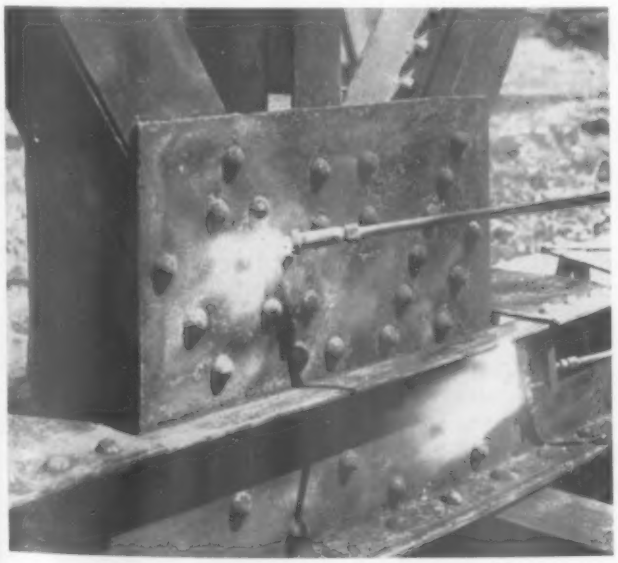

Fig. 4—How equipment is used for burning paint off of steel structures. Wire brushing will then remove loosened rust, scale and paint. Photo (Airco).

cleaned by power wire-brushing and carefully repainted.

Of more recent date is the recognition that dehydration of the surface, i. e., the driving therefrom of all moisture, is an essential. If moisture is present when repainting occurs, it will continue its destructive action so that within a year or two, and frequently less, inspection will show paint-lift and oxidation.

A superior method of paint-burning and surface-conditioning is provided by the oxy-acetylene multi-flame apparatus. Quick results are obtained by using the round tip with multiple orifices on rivet-heads and irregular surfaces, and the various width flat tips for plane surfaces. The flames are quickly passed over the scaled, rusted and painted surface with a progressive reciprocating action. Rust and scale are freed and the old paint is caused to loosen.

Sufficient heat is imparted to drive off moisture and to remain until painted, but not enough to cause any injurious action to the structure. Power wire-brushing immediately follows removing the loosened rust, scale and paint. A warmed, clean, dry surface is provided which is beneficial in obtaining a lasting paint job.

Where seven or eight coats of old paint are encountered, several passes of the flames with intermittent light hand wire-brushing can be employed. After the last flame passage power wire-brushing generally follows. Considerable success has been experienced using a multi-flamed flexible head tip on which the heads can be spread apart or bunched together as desired to fit the dimension and shape of structure being cleaned. Where advisable, scrapers may be employed between and after flame passes. If deterioration has progressed to an unusual degree resulting in a measure thickness of iron oxide, it is advisable to flake off such accumulation with scrapers beforehand.

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TECHNICAL SESSIONS

Hotel Schroeder, Milwaukee, Wis.

Looking at the underside of a welded aluminum sailboat. Fabricated mostly by resistance welding. Photo (Aluminum Company of America).

Welded Sailboat of Aluminum Alloy Weighs Only Half of a Wooden Boat

★ The lively sailboat *Pirouette,* unique for her all aluminum alloy hull, unusual form and simple construction, also merits attention because of her resistance - welded joints. Designed by W. Starling Burgess, the *Pirouette* was built during the past year by the Aluminum Co. of America at New Kensington, Pa., using intermittent seam welds wherever possible. Such welds proved to be cheaper than rivets, and just as strong, watertight and pleasing in appearance.

A V-bottom centerboard type, the *Pirouette* is 16 ft. over all, with 5 ft. 2 in. beam, and carries 125 sq. ft. of sail in mainsail and jib. Because she is built of aluminum she weighs but 217 lb. without her rig, or only half as much as a wooden boat of the same size. Her hull and deck plating is but 1/16 in. thick, her centerboard and rudder only 5/32 in. thick.

Not only is the *Pirouette* economically welded, but she is so designed that the proper shape is obtained without the use of double-curved surfaces which are expensive to fabricate from metal. Each of the two bottom plates is formed from a single sheet, flat at the stern and increasing in curvature to full rounded sections at the bow. The side plates are as if cut from a cylinder, the angle they make with the water being constant.

The bottom and side plates were joined by seam welding to 5-in. strips of metal known as chines. Since an intermittent, not continuous, electric current was used, the resulting joint is equivalent to a spot-welded joint. Before being joined, the bottom plates, side plates and chines were assembled on a wooden form with the same shape that the hull was to have. The entire assembly was tied together by means of iron straps, and Parker Kalon screws inserted every 6 in. along the chine.

The hull was then removed from the form and completely disassembled so that it could be prepared for welding. Screw holes were cleaned out,

Looking at the bow of the "Pirouette" from underside. Note details of keel and two chines. Photo (Aluminum Co. of America).

The "Pirouette" is said to be first welded aluminum sailboat of her type. She weighs only 217 lbs. without her rig. Photo (Alcoa).

faying surfaces rubbed down with emery cloth, and Alumilastic compound applied to insure water-tightness. This compound is squeezed out by the welding pressure at each weld and provides a flexible seal in the faying surfaces without interference with the weld.

Assembly Sequence

The bottom plate was first joined to the chine. With these two parts held in place by the screws, two rows of welds were made—the outer row spaced one spot to an inch, the inner row, four. This is done at a faster rate than continuous seam welding, in which ten overlapping spots to the inch would be made.

The side plate was welded to the chine in similar fashion, and when the joint was complete, it was finished with a disc grinder for the sake of appearance. Finally, the screws were replaced by countersunk rivets.

The two bottom plates were riveted to the keel, and the bulkheads to the hull, because they could not be reached by a seam welder. Torch welding was used for welding the corners of flanges, the sheets forming the centerboard trunk and similar details.

In addition to the chine, the following aluminum-alloy stiffeners were attached by seam welding: (1) four extruded Z sections joined to the bottom of the boat to stiffen it longitudinally; (2) several angles which serve a dual purpose of stiffening the centerboard trunk and supporting floor boards; (3) formed sheet channels, 2½ in. deep, reinforcing the underside of the deck.

In building the *Pirouette*, aluminum alloys were used throughout. Their light weight is important in handling the boat on the water. As constructed, the bottom is leakproof, and the bulkheads will remain tight without caulking. Because of its strength, aluminum need be but one-eighth as thick as wood.

The performance of this unusual sailboat is best described by one who has sailed her—Miss Marjorie G. Young, who recently stated:

"To sail a boat of this incredible lightness is a joy. While having ample stability, she responds to every puff. Curiously enough, she performs much better in heavy than in light winds. When the air is almost still, she bobs like a cork and slats the wind out of her sails. When the breeze comes, she answers instantly. When it really blows, with the crew on the weather rail, and skipper too, if necessary, she is as stiff as a church and ships hardly a drop over the lee rail."

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Mobile X-Ray Machine Aids Welded Production in Shop

By LAWRENCE D. JENNINGS*

★ The modern fabricating shop has adopted radiographic examination of welded joints, castings, and metallic assemblies as a desirable means of determining the inner structure of important items to facilitate production schedules and aid the design and manufacturing engineer in formulating a successful manufacturing procedure.

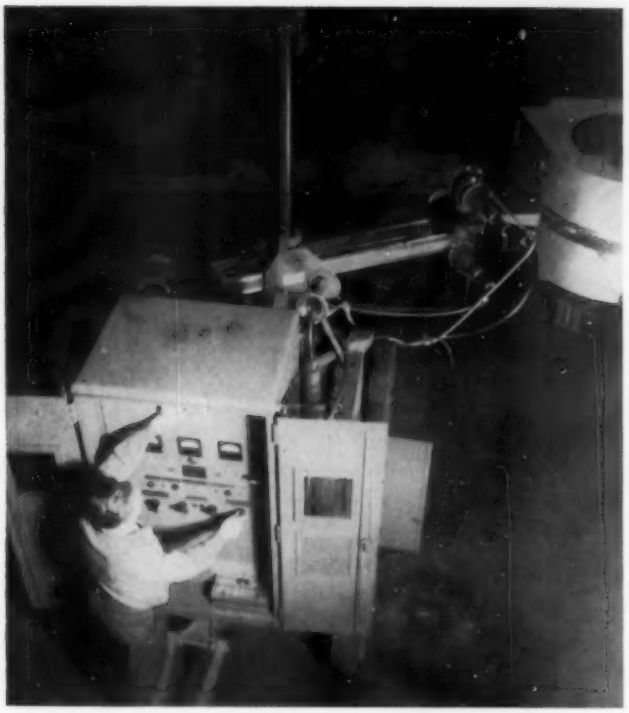
X-ray equipment may be of either the stationary or mobile type. Stationary equipment is desirable where small objects are easily taken to the X-ray booth; but recent developments and improvements with shock-proof X-ray tubes have made mobile X-ray units practical. The mobile unit is extremely valuable to the fabricator because of the ease by which radiographs of massive structures are obtainable at various locations in the manufacturing aisle.

The East Pittsburgh Works of the Westinghouse Electric & Mfg. Co. has recently installed a 200-kv mobile unit to facilitate shop and procedure inspection. The X-ray machine is a self-contained unit mounted upon an automobile chassis equipped with heavy balloon tires to facilitate moving about the production aisle. The equipment consists of a 400-lb. shock-proof, oil-cooled X-ray tube mounted upon a counterbalanced arm with three-dimensional adjustment, two large transformers, and oil-circulating pump, rectifier tubes, and a lead-lined operator's booth with control panel.

An automatic timer, voltage-control

*Manufacturing Engineer, Generator Works Dept., Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

A 220-kv. industrial mobile x-ray unit used to radiograph welded and cast structures in a fabricating shop. Photo (Westinghouse).



Radiographing a welded structure in a production aisle at East Pittsburgh Works of Westinghouse. Unit is rated at 200-kv. Photo (Westinghouse).

switches, and the necessary meters are conveniently displayed on the control panel. Single-phase 220-volt power is used and is transformed for tube consumption to from 60 to 218 kv. in 2-kv. increments. Variations in line voltages can be compensated for to insure a constant primary potential. The machine is capable of producing radiographs of ferrous alloys from ⅜ to 3 in. in thickness with two per cent sensitivity.

Numerous Uses

This unit has aided in selecting suitable welding electrodes for high quality weldments, the qualification of welding materials, methods and operators, and the inspection approval of weldments, castings, and forgings. When a high quality weldment free of porosity is required, it is a long and expensive task to machine and physically examine a series of weld deposits; but when radiographs are available, it is quite simple to determine the soundness of the weldment.

Welder qualification is aided and often simplified by the use of X-ray. Many codes require X-ray examination as a portion of each qualification test along with physical tests; but when the manufacturer desires to qualify his operators, he usually has a good knowledge of the capabilities of each operator, along with the physical properties of the weldment deposited by the electrodes used, and then a radiograph will display the inner soundness of the weldment as well as indicate irregularities of welding procedure and electrode manipulation.

The welding fabricator will notice a marked increase in weld appearance soon after the installation of X-ray equipment, because the welding operator is awakened to the fact that what he thought was a sound weld deposit may contain numerous gas or slag inclusions when radiographed. With the aid of radiographs, the welding engineer can point out the objectionable faults of a weldment to the operator and advance corrective methods. Production is aided by improved quality and appearance by radiographic spot inspection of welded structures.

The fabricator frequently has cast or welded structures on which a large amount of machining must be performed, and should a defect appear during machining, a considerable loss may be experienced. Radiographs of the castings or critical weldments prior to machining will determine the homogeneity of the material and remove all doubt as to quality of the material. This type of inspection often saves unnecessary machining and aids production schedules with the early discovery of defective material.

Foundry engineers can profit from radiographs of new and intricate castings, as the radiograph will record defective areas without destructive inspection. The engineer with this knowledge can analyze and correct the casting technique.

Mobile X-ray units are valuable tools to the fabricator. The unit can be moved quickly up the aisle to the structure to determine its homogeneity. It is a great aid to the design and manufacturing engineer in establishing desirable procedures. In short, the mobile X-ray unit is an aid to production.

» «

Hard-Facing Technique

(Continued from page 25)

These applications illustrate only a few of the thousands of satisfactory hard-facing deposits that are made daily using the electric arc process. However, while using the electric arc process for the deposition of hard-facing materials it should be remembered that: (1) In depositing hard-facing materials by the electric arc process, the lowest welding current which will give sufficient speed for operation should be used. This will insure the obtaining of maximum hardness with a minimum of deposition imperfections.

(Part 5 of this series will discuss the effects of multiple-bead deposits upon ultimate hardness of overlay. This installment will appear in the April, 1940 issue.)

Arc welding a steel-framed structure for a state institution in Kentucky.

TABLE A—Comparison of Competitive Prices

	Highest Bid	Lowest Bid	Company Design
Prices delivered	$4520.00	$1350.00	$548.38
Water required at 90 deg. F. (g.p.m.)	27	50	35
Temperature difference between incoming water and outgoing air	3 deg. F.	10 deg. F.	5 deg. F.
Delivery time, weeks	8	6	2

(1) Prices cover coolers for both 500-lb. air and 1000-lb. air and include freight.

(2) Water required by the company-built cooler is estimated from a test made at one-half load, ample allowance being made for reduced efficiency at higher load.

(Continued from page 26)

stages. It was considered expedient however, to provide a means of cooling the air before and after the third stage of compression, from 500 lb. to 1000 lb. in the small compressor. This prior-cooling is principally to improve the efficiency of the high-pressure machine; the after-cooling is to minimize the danger of explosion in the high-pressure line.

Comparative Quotations

Various designs of air coolers (or heat-exchangers) were considered for this service. Quotations on conventional after-coolers were taken from various manufacturers. Prices, deliveries and guarantees of performance varied over a wide range. Principally because of unsatisfactory delivery promises, the company determined to design and build its own cooler. Table A presents a tabulation showing a comparison of prices, performances, and deliveries, (1) offered by the highest bidder with the best performance guarantees, (2) offered by the lowest bidder with the poorest performance and (3) as actually recorded by the company, in building and operating its own design. The substantial savings in time and money indicated in Table A were made possible by arc welding.

Details of construction of the company-built cooler are shown in Fig. 2. Essentially the cooler consists of two concentric spiral coils of steel pipe standing vertically in an open steel tank. The 500-lb. coil is made of 6 lengths of 3 in. extra-heavy seamless steel pipe welded together and bent into a spiral comprising a total of 128 ft. of pipe, or 107.3 sq. ft. of cooling surface. Similarly, the 1000-lb. coil is made of 5 lengths of 2 in. extra-heavy seamless steel pipe welded and bent into a spiral having a total cooling surface of 68.4 sq. ft. These two coils were fabricated at a local pipe bending shop. The tank itself is made of ¼-in. steel plate, rolled and welded into a 4 ft. diameter cylinder, with a ¼-in. flat plate welded in for a bottom and light angles for flanges bent and welded to top and bottom.

The lower end of each coil is bent to hook out radially. When the cooler was assembled, the coils were lowered into the tank one at a time. The radial ends were pushed through holes cut in the side of the tank near the bottom and when the coils were in the proper position, these radial ends were welded to the tank around the holes. Chair or "feet" had been tacked to the bottom round of each coil for supports. Several vertical pieces of light angle iron (not shown in Fig. 2) were arc welded to the coils to insure their uniform spacing vertically. The upper ends of the coils were bent to hook upward.

As can be seen from Figs. 1 and 2, all connections into and out of the coils and tank up to the control valves were arc welded. The small cylinders shown at the outlets of the two coils are moisture separators (100% arc welded).

Costs of these moisture separators are not figured in Table A, but cost us, fabricated as shown, $15.02 respectively, as compared with $150.00 and $250.00 quoted for comparable manufactured articles. Actual cost of construction ($548.38) can be broken down as follows:

Tank	$ 86.00
3-in. coil	275.00
2-in. coil	90.00
Freight	5.76
Labor assembling and arc welding	86.40
Supplies and power	5.22
Total Cost	$548.38

Because the performance guarantees as shown in Table A are in neither case directly comparable with the results obtained from the company-built cooler, we cannot make a dollar-for-dollar comparison. Also a direct comparison would ignore the time element which in this particular case was the vital factor.

However, if we take a very conservative view of our savings, we may add, say $300 to the amount of the lowest bid ($1350) to compensate for the better operating results by the company-built cooler over the lowest bid

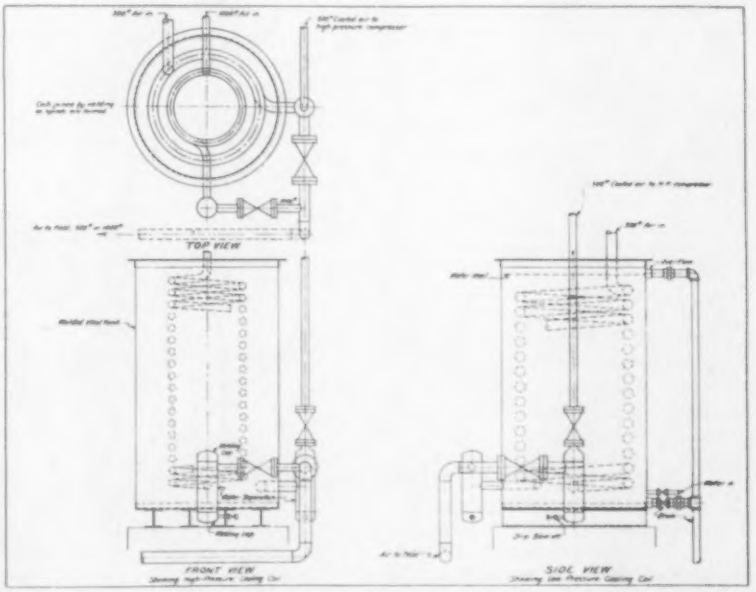


Fig. 2—Details of the simple arc welded design of company-built air cooler. Note use of two concentric spiral coils.

received. Thus we will have a comparative figure of $548.38 for the company-welded design as against $1650 for the lowest bid manufactured unit on the compensated basis. This means an indicated saving on the unit of $1650 less $548.38, or $1101.62. This amounts to about 67% saving.

The application of this open welded spiral coil type cooler to innumerable other heat exchange problems will be found practical and advantageous. In addition to savings in time and money, we can point out the following features:

(1) Practically any wear, corrosion or injury to the exchanger may be promptly repaired by arc welding on the job without waiting for shipment of parts.

(2) Any alteration or major replacement of parts may be made by arc welding with materials readily available in any part of the country.

(3) Pressure drop of all fluids through the exchanger is negligible.

(4) Due to the exchanger being open and having ample spacing between parts, cleaning and scaling becomes a simple problem.

(5) Inspection of the internal condition of the exchanger is merely a matter of looking in the top of the tank.

(6) A wide variety of conditions of operation may be met by alteration of details of construction. (For example, a small amount of baffling, would perhaps considerably improve the water efficiency.)

» «

Fig. 2—Movement of the control pole is effected by a handwheel mounted at top of the machine. This provides stepless adjustment of current.

New Products

New Electrical Design Places Control Inside of Generator

By IRA B. YATES[1]

★ At the 1939 National Metals Exposition, Wilson Welder and Metals Co. made its first public showing of a new arc welding generator which has been christened the "Hornet."[2] The electrical design of this machine utilizes several basically new features that result in a unique and highly efficient welding unit. Table 1 is a summary of typical performance data on such items as can be measured by standard laboratory tests. These data show quantiatively the qualities that are generally recognized as desirable. Of more interest to the operator is the method of control of current output.

The use of separate reactance or resistance units has been eliminated by incorporating the current control in the generator itself. In order to accomplish this, one pole of the generator (known as the control pole) is (1) provided with the regular aid gap and in addition it has a second or auxiliary air gap, and (2) so mounted that it is movable along its axis, permitting variations in the air gap, which in turn has the effect of increasing or decreasing the strength of the magnetic flux, with the result that the current output is correspondingly increased or decreased. In other words, one setting of the control pole determines a definite welding current. No other adjustment is necessary. Movement of the control pole is actuated by a handwheel at the top of the machine, through a threaded bar—a stepless adjustment. A pointer mounted in the handwheel indicates the current setting on a calibrated dial.

To set this machine for a given electrode the operator turns the handwheel until the pointer indicates the proper current. In doing this he moves the control pole into position to establish a magnetic flux which will hold the current output at this desired value. The "single-pole control" is therefore not an external control or appliance, but an inherent feature of the generator itself. The operator has a current that is not only predetermined and certain, but also uniform throughout the melting of the electrode.

Accuracy demands that exception be taken here for abnormal arc length conditions. The machine setting is assumed to regulate current output when the arc gap is held within the normal range of length for the electrode used. No hand can feed the electrode to the work and avoid the tiny variations of arc length which are caused by irregularities in the stream of molten metal across the arc. However, there is a small tolerance within which the expert welder can usually hold.

The less expert operator will wander more or less out of the correct arc length range, according to his ability; and all operators are subject to the extreme of short circuiting at the instant of starting. The rapidity with which the current assumes its proper value when the normal arc length has been re-established has much to do with lessening the fatigue of the operator, and with the soundness of the deposited metal. It is called recovery time, and fast recovery is synonymous with the frequently used term, arc stability.

It is apparent that a welding generator in use is constantly called on to recover from changes in arc length. One of the important contributing factors to quick recovery is the provision for constant excitation of the pilot pole (Fig. 1) which result in a continuous flow of magnetic flux always in the same direction. The arrangement is such that the value of the magnetic fluxes in this pilot pole remains practically constant regardless of machine output. When a load or short-circuit is applied, these fluxes are merely diverted from one path to another and as soon as the normal arc length is established, the fluxes resume their normal path, very much as the flow of a liquid can be diverted from one channel to another by means of a flow valve. When the arc gap lengthens or shortens within the range

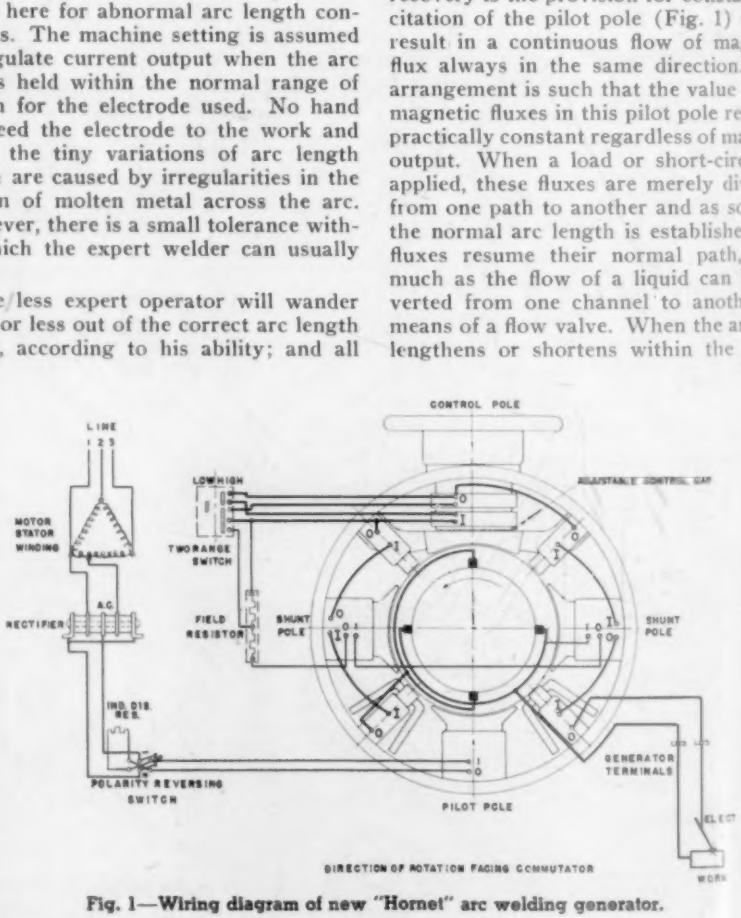


Fig. 1—Wiring diagram of new "Hornet" arc welding generator.

[1] Wilson Welder & Metals Co., New York City.
[2] Trade-Mark Reg. U. S. Pat. Off.

TABLE 1—Electrical Characteristics of Generator

	200 Amp.	300 Amp.	400 Amp.
Recovery Time, seconds 60% load	.185	.135	.20
90% load	.185	.150	.20
Efficiency at 30% of rating	51%	53%	54%
At 50%	59%	61%	63%
At 75%	57%	62%	63%
At 100%	59%	60%	62%
At 125%	54%	56%	56%
Power Factor at no load	30	31	31
At 30%	59	65	65
At 50%	72	72	72
At 75%	77	83	83
At 100%	85	87	87
At 125%	86	87	87

that permits metal deposition, this constant pole excitation and the single-pole control feature combine to hold the current at the right value for good penetration.

An interesting by-product of this new design is the smooth streamlined appearance of the machine, which resembles a metal capsule, with the control handwheel at the top as its only protruding part. This is due to the fact that the self-contained control features of the generator have done away with the necessity for external control boxes or devices such as resistors, reactors, exciters or meters. The operator has fewer items to watch or to adjust.

It is not practicable to evaluate the performance of a welding machine in terms of melting rate, due to the varying characteristics of electrodes. A more reliable index is the effect on total arcing time. There is a general agreement that the average plant welder spends a maximum of 50 to 60% of his time depositing metal when conditions are most favorable; and that 40% deposition time would be a very high average figure. The remaining time is consumed in changing electrodes, making adjustments and resting. The substitution of a single control, for various combinations of adjustments gets rid of one source of delay; but certainly more important is the effect of quick recovery in lessening fatigue.

In this non-technical description of the welding circuit it is possible only to indicate broadly that its basic characteristic is the incorporation of all control and of all volt-ampere adjustment in the generator windings, so that the stabilizing of the arc is automatic and smooth. The objective of better production is thus reached by way of reduction of idle time and easy maintenance of proper current density for deposit of sound metal.

» «

Parker-Kalon Hardened Welding Studs

★ Parker-Kalon hardened welding studs save time and labor in the preparation of welding jobs, by eliminating the tedious and slow hand-tapping operation required when ordinary machine screw thread studs are used. These unique studs form their own threads in the metal when driven into a hole of the proper diameter, thus producing a precision screw fit that has greater holding power than bolts or studs screwed into tapped holes. Furthermore, because they eliminate laborious hand tapping, the cost of making welds is appreciably lowered.

To use these welding studs, simply drill holes of the recommended diameter for each size of stud to a depth of approximately the length of the thread portion, then drive the stud home with a hammer and weld around it so that it becomes fused to the metal into it is driven. The following hole diameters are recommended for Parker-Kalon hardened welding studs:

Diameter of Stud	Decimal Equivalent	Hole Diameter	Drill Size
No. 14	.239″	.221″	No. 2
5/16″	.312″	.281″	9/32″
3/8″	.375″	.349″	Letter S

Parker-Kalon studs are made of stock in the following sizes: No. 14 x 1¼ in.; 5/16 x 1¼ in.; ⅜ x 1¼ in., and ⅜ x 1½ in.

» «

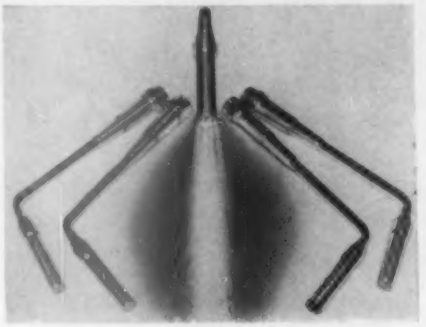
"Rego" Multiple Tips For Hard-Surfacing

★ A new group of tips, designated as the Rego GXH series, is available in four different sizes (GXH72, 68, 60 and 56). These tips make it possible for any experienced operator to produce hard-surfacing jobs free of soft spots and pin holes. Every welder who has used these tips on field tests approved them because of the smooth soft flame operation, speed and excellent results obtained.

Rego multiple tips as manufactured by The Bastian-Blessing Co., 242 East Ontario St., Chicago, Ill., offer these advantages:

(1) Multiple-hole tip construction permits high heat output, yet produces a soft, brush-like flame that eliminates turbulence in the weld puddle, thereby preventing detrimental pin-holes in the applied hard-surfacing material after it has cooled.

(2) The wide flame by the GXH tips



Rego GXH multiple tips designed especially for hard-surfacing applications.

makes it easier for the operator to keep the weld zone and the rod in a protective carbonizing flame envelope, thus eliminating harmful oxidation.

(3) Individual mixer in each tip assures correct gas mixing and economical operation.

(4) Low equipment cost because GXH tips are designed for use with standard Rego GX or SX welding torch handles.

» «

Super-Duralite-50 goggle.

Super-Duralite-50 Safety Goggle

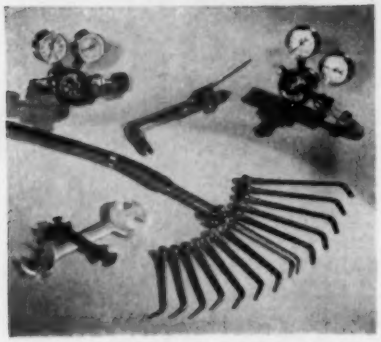
★ American Optical Co., Southbridge, Mass., announces the No. 303 Super-Duralite-50 safety goggle with a non-rubber headband. This new goggle has not only all the proven advantages of the Duralite-50, but combines with them several important features which assure added comfort and long life.

The eyecups are molded from a special material that combines light weight for comfort with high tensile strength for long wear. This material is said not to be affected by exposure to water, oil, grease, and perspiration. It can be sterilized by any method without harm. Automatically designed, these eyecups have broad bearing surfaces, and are low set to provide wide-angle vision.

The non-rubber headband consists of a spring and ball chain covered by a cloth sleeving. The chain prevents over extension of the spring, yet permits instant adjustment to any desired head size. When adjusted it maintains the same tension indefinitely but may be readjusted for different head sizes.

Lenses regularly supplied are the 6.00 curve clear Super Armorplate type. The caps which hold the lenses in place are precision threaded to insure easy removal for replacement of lenses. Metal screens provide adequate ventilation.

New Product Developments



Victor two-stage reduction regulators for light-gauge welding.

For Light Gauge Metal Welding and Cutting

★ The welding of light gauge metals in the aeronautical, body and fender and sheet metal industries requires a good welding outfit. For accurate flame maintenance and control, two-stage reduction regulators have been designed for exceptional pressure accuracy and freedom from "freezing." The welding torch should be of proper dimensions and weight distribution to facilitate ease of operation. Within the more limited scope of necessary flame sizes, a larger-than-usual nozzle size selection should be offered. Victor Equipment Co., 844 Folsom St., San Francisco, Calif., now offers such an aeroplane welding and cutting unit.

New, light weight, accurately functioning two-stage reduction oxygen and acetylene regulators, Models VTS-95 and VTS-96 respectively, are claimed to be particularly suitable to control these small welding torch flames. The new Victor Model J-20 welding torch is provided with a specially designed needle valve construction permitting instant flame adjustment by the operator's thumb. This torch can be furnished with 13 graduated nozzle sizes from No. 000 to No. 4. Each welding torch nozzle is provided with its integral and Victor-patented gas mixing device properly controlling gas ratios and exit velocities.

The cutting attachment can be fitted on to this welding torch butt instantly and offers a cutting range of bar diameters up to 2½ in.

» «

Haynes "93" Hard-Facing Rod

★ Haynes "93" hard-facing rod, a new alloy welding rod for hard-surfacing wearing parts, has been announced by Haynes Stellite Co., a unit of Union Carbide and Carbon Corp. It is recommended for use where severe abrasion, accompanied by only a moderate amount of impact, is encountered. It has proved successful on dredge pump impellers, cement clinker crusher rolls, slag crusher roll teeth, cinder crusher rolls, tamper feet for cinder block manufacturing, tube bending mandrels, farm implements, and other wearing parts.

The new alloy rod does not possess as high wear resistance as Haystellite cast tungsten-carbide products or Haynes Stellite alloys. It is, on the other hand, more wear-resistant but not as tough as Hascrome hard-facing alloy. It thus enables Haynes Stellite Co. to offer a more complete line of hard-facing materials ranging from the toughest, most impact-resistant, to the hardest, most wear-resistant types.

Haynes "93" alloy rod is of a ferrous composition and contains chromium, molybdenum, cobalt, and other alloying elements to the extent of more than 40%. It has a tensile strength of about 43,000 psi. and a hardness, as-deposited by oxy-acetylene welding, of 62 Rockwell C. When deposits are heat-treated by heating to 1,950 deg. F. and then air-cooling, the hardness reaches 66 to 67 Rockwell C.

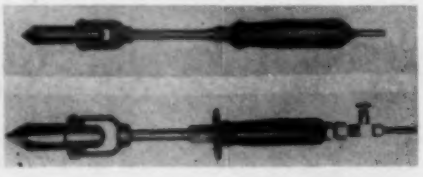
Application of Haynes "93" alloy rod is relatively simple. It can be applied by either the oxy-acetylene or the metallic arc process. It is readily handled with a slightly carburizing (excess acetylene) flame. When the new rod is applied by the metallic arc process, reversed polarity is used, and flux-coated rods are recommended. Haynes "93" rod is available from Haynes Stellite Co., Kokomo, Ind., and from resellers.

» «

Prest-O-Lite Soldering Irons

★ Two new soldering irons of the open-flame type have been announced by The Linde Air Products Co. These soldering irons are available as part of the Prest-O-Lite line of air-acetylene equipment. A constant source of just the right amount of heat is provided by the air-acetylene flame. This heat is instantly available, and once the work is started there are no interruptions to reheat the copper, since the flame is an integral part of the soldering iron. In addition, the copper is kept at a constant temperature due to the stability of the flame. These factors mean increased operating speed with resultant economy, and unusually uniform results.

The small soldering iron is particularly well suited for automotive, electrical, telephone switchboard, and radio work, while the standard soldering irons are capable of handling all but the heaviest operations. Both the small and the standard size are furnished with pointed-type coppers, but chisel-type coppers for the small iron, and chisel- and hatchet-type coppers for the standard iron are also available. In addition, the standard iron can be supplied with a needle valve in the handle which permits exact regulation of the flame. This feature makes the iron particularly suitable for outdoor work, especially in cold weather.



(Top) Small and (Bottom) Standard Prest-O-Lite soldering irons.

» «

New Flint Lighter

★ The Flint Products Co., 2176 Nostrand Ave., Brooklyn, N. Y., has placed on the market the Hercules gas lighter, which is said to embody some new ideas in lighter construction. The Hercules lighter, shown below, is made of heavy, flat band steel and is equipped with a high-grade round file. It possesses a reversible flint which is said to provide substantially longer life.

Hercules flint lighter for torches.

» «

Ventilated Ear "Muffs"

★ New protection for welder's ears is the subject of Mine Safety Appliances Co.'s Bulletin No. CF-4, entitled "M.S.A. Welders' Ear Protectors." This is a simple and practical device for preventing injury to the ears caused by entry of flying sparks or hot metal particles. The two ear protectors are made of close-woven, non-rusting screen with leather binding, and are held comfortably in place over the ears by an adjustable spring steel headband. The ear protectors are deeply cupped, ample in size to avoid cramping the ear, and permit complete natural ventilation and hearing. The headband is worn around back of the head, and does not interfere with the wearing of goggles, conventional welding helmets or any head covering, it is stated.

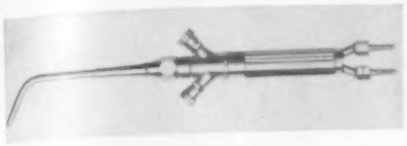
Bulletin CF-4 will be sent free on request to Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh, Pa.

» «

New Oxweld Blowpipe For Light Welding

★ A new oxy-acetylene welding blowpipe, for welding light-gauge metal has been announced by The Linde Air Products Co., a unit of Carbide and Carbon Corp. Although this blowpipe, known as Oxweld (Type W-29) welding blowpipe, was specially designed for welding in light production work and in aircraft construction, its field of usefulness extends to all applications in which metals up to ⅛ in. thick are to be joined.

Its light weight (15 oz.), small size, and slender lines make it unusually well suited to welding in relatively inaccessible places, or for production line work. Both



Oxweld Type W-29 welding blowpipe for light welding.

valves on the W-29 are located at the forward end of the handle where they may be readily adjusted by thumb and forefinger, leaving the other hand free. The "pencil point" welding flame is concentrated, yet "soft" enough for excellent control of the welding puddle.

Strongly constructed, the W-29 offers continued operation with a minimum cost of maintenance, because of such refinements as "packless" valves and valve stems shielded against knocks. It features increased flashback resistance, greater valve capacity than is usually found in blowpipes of this size, and small size screw-type hose connections on the blowpipe handle, which allow the use of 3/16-in. hose for full blowpipe capacity. There are eight welding heads, each with a built-in injector, and each available in both the one-piece tip and the two-piece tip styles. Either low-pressure or medium-pressure acetylene can be used.

Further information about this new blowpipe, which replaces the W-15 welding blowpipe in the Oxweld line, can be obtained from any office of The Linde Air Products Co.

» «

Heavy-Duty A-C. Arc Welders

★ Two new single-transformer heavy-duty welding sets, G-R Models 38 and 45, with ranges of 75 to 425 amp., and 90 to 600 amp. respectively, have been announced by Glenn-Roberts Co., Inc., 1009 Fruitvale Ave., Oakland, Calif. These two models are designed for continuous heavy-duty service and feature the G-R infinitely-variable heat control which provides full-range regulation of output current without altering arc or open-circuit voltage.

G-R a-c. transformer type arc welder.

This type of control is accomplished without breaking or changing electrical connections, and regulation over the full current range of the welder is controlled by an easily-operated handwheel located on top of the unit.

Glass-covered wire, mica insulation and a special heat-resistant baking varnish is used throughout all coils on the transformer. The new units are designed to operate with the standard G-R remote control equipment, which permits current regulation directly from the electrode holder.

» «

Weltronic's new half-cycle timer permits improved welding of stainless steel, brass screen, copper lugs, etc.

Split-Cycle Timing For Welding Thin Sections

★ Ability to control welding time to a half cycle of current, on any resistance welder, is provided by a new weld timer announced by Weltronic Corp., 2832 E. Grand Blvd., Detroit, Mich. Built as a separate unit the timer may be adapted to virtually any standard resistance welding machine. It is recommended particularly for welding thin section stainless steel, aluminum, brass, screen, copper lugs and similar applications where unusually high heat and close control of welding time is essential.

Known as "Model 90-1" the timer is available in 220 to 550 voltages with frequencies of 25, 50 and 60 cycles. Amperage range of 150 to 600 is also available. Use of "split-cycle" timing heretofore has been restricted to complete new welding machines having the half-cycle timer feature as an integral part of the machine. The new unit consists, essentially, of only two moving parts (the relays) in addition to one electronic and one rectifier tubes; all of which are panel mounted and enclosed in a hinged-cover case. Bulletin describing the new "Model 90-1" timer is available on request to the company.

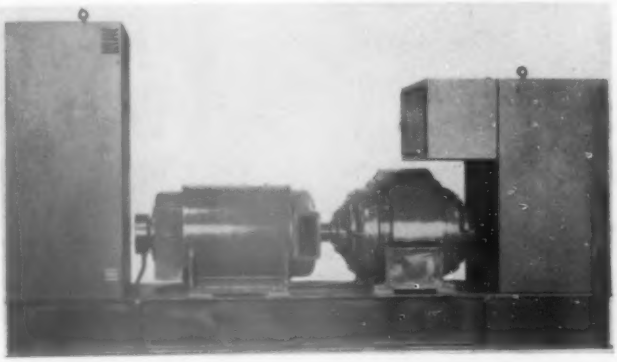
» «

General Electric Improves Multiple-Operator Welding Sets

★ Redesign of General Electric's 1500-amp. constant-potential arc-welding sets for multiple-operator and machine welding has resulted in more compact construction, lighter weight, improved appearance, and greater ease of installation. In addition, the improved equipment has the control for the motor and generator mounted on the base, making for greater convenience for the operator.

Constant-potential motor-generator arc-welding sets are said to be especially suited for supplying the heavy current demands of modern automatic welding and the exacting requirements of production hand-welding by a number of operators. Where a number of operators are to be supplied from one set, advantage can be taken of the fact that the average hand-welding operation is not continuous. This diversity factor of welding load allows the use of a smaller-capacity set in supplying a given connected load than would be required if each operator were supplied by a separate set, and because one large machine supplying a number of welding stations can operate at all times near its most efficient load point.

The sets are equipped with standard driving motors for operation on direct current, or on polyphase alternating current at any commercial voltage. Synchronous driving motors may be used to obtain plant power-factor improvement. This often results in materially reduced power bills.



Two-unit constant-potential arc welding set. D-C. generator rating: 150 kw., 70/70 volts, 1500 amp. Driven by 160 hp. 2200 volt induction motor.

Cesco No. 220 wide-vision goggle.

Wide-Vision Goggle Offers Many Advantages

★ A full 150 deg. effective range of vision is offered in the new, improved No. 220 wide-vision goggle illustrated herewith, one of the latest developments of Chicago Eye Shield Co., 2360 Warren Blvd., Chicago, Ill. This is said to obtain the widest practical amount of working vision through the medium of lens-embodying eye-protective devices. Hardened safety lenses provide maximum protection against severe impacts. Both lenses are easy to renew, by sliding them through the outer side of each eye-cup, and inserting the replacement.

One of the important features found in the new Cesco 220 wide-vision goggle consists of the new one-piece moulded cushion pad, which is composed of a very pliable material highly resistant to perspiration. These cushion pads are said to conform to varying contours of practically every wearer, seating each eye-cup comfortably and snugly. Additional ventilation holes, in the rust-proofed metal portion of the eye-cups, increase cool air circulation. The nose bridge is adjustable to varying facial widths.

» «

Welding Blowpipe and Cutting Attachment

★ A new medium-pressure oxy-acetylene blowpipe for welding light-gauge metal, and a cutting attachment for cutting iron and steel up to 1 in. in thickness, have been announced by The Linde Air Products Co. The blowpipe, known as the Pres-O-Weld (Type W-109) welding blowpipe, is specially designed for welding in light production work and in aircraft construction. Its field of usefulness includes, however, all applications in which metals up to ⅜ in. in thickness are to be joined. Field tests have proved it equally well adapted for sheet metal welding, automobile fender and body work, radiator repair, and dental and jewelry work.

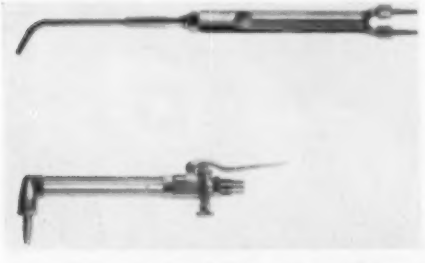


Fig. 1 (Above) Prest-O-Weld (Type W-109) welding blowpipe will join metals up to ⅜ in. thick.

Fig. 2 (Below) Prest-O-Weld (Type CW-109) cutting attachment will cut iron and steel up to 1 in. thick.

Because it is slender, light, and well balanced, it can be used over extended periods with a minimum tiring effect on the operator and is suitable for welding in hard-to-reach places. Both valves are conveniently located at the forward end of the handle, where they can readily be adjusted by thumb and forefinger of the hand holding the blowpipe. "A" size, screw-type hose connections facilitate connecting and disconnecting the blowpipe. There are eight sizes of welding heads for the W-109 blowpipe, each with an individual mixer. These individual mixers make the heads less sensitive to pressure fluctuation, extending their range so that fewer heads are required.

The Prest-O-Weld (Type CW-109) cutting attachment, for the cutting of sheet metal and light plate up to 1 in. thick, attaches directly to the W-109 blowpipe handle in place of the welding head. The combination of the W-109 and CW-109 forms a useful, well-balanced unit. The attachment features an improved cutting valve with rubber-seated stem, and a cutting valve lever that can be turned back 90 deg. to permit ready access to the cutting valve assembly, and for easy connection to and disconnection from the blowpipe handle. Two cutting nozzles are supplied, the No. 0 which will cut iron and steel up to ¼ in. thick and the No. 1 which will cut up to 1 in.

» «

"Mine Safety" Faceshields

★ Intended for use on jobs where goggles are not absolutely required, yet protection to the face desirable, the new M.S.A. faceshields are said to afford comfortable protection against hot sparks, flying grit and dust, etc., and are available in three models: without sparkshield, with semi-sparkshield, and with full sparkshield.

Pre-formed headgear, which conforms to the natural contours of the back of the wearer's head, as distinguished from ordinary oval "hat-band" construction, is a feature stressed by the manufacturer. Other features are the headgear's center-top strap, which supports the light weight of the shield without pressure on sides of head, the three-way, full headgear adjustment, finger control of friction adjustment permitting easy visor movement, and the aluminum binding of visor edge. The visor, which may be pushed upward and back on top of the head at will, is made of plastic in 4 in., 6 in. and 8 in. sizes, in green as well as clear. Easy and inexpensive replacement of all unit parts is stressed. The headgear is constructed of high-quality moisture-resistant fibre, and sweatbands are of genuine leather.

Complete details regarding the line are contained in Bulletin No. CE-11, a copy of which may be obtained free by writing to Mine Safety Appliances Co., Braddock, Thomas and Meade Streets, Pittsburgh, Pa.

How the G-E fillet weld gage is used.

G-E Gage Speeds Accurate Checking of Fillet Welds

★ A new low-priced fillet-weld gage has been developed by General Electric Co. to meet the need of welding inspectors and operators for a fast, accurate means of checking the size of fillet welds on jobs which have to meet rigid specifications. The new device, which slides readily into a shirt or trouser pocket, is of extremely simple construction, consisting of three stainless-steel stampings held together by a bolt and a knurled thumb-nut. Either convex, concave or standard fillets can be checked, merely by fitting the edge of the gage flush against the work so that the indicating portion of the gage rests on the weld bead. The gage can be used on fillets of the following sizes: 5/16 in., ⅜ in., ¼ in., 7/16 in., ½ in., and ⅝ in. These sizes are clearly marked in black on the gage.

» «

Lincoln Has New Stainless Steel Electrode

★ A new stainless steel electrode known as "Stainweld D" is announced by The Lincoln Electric Co., Cleveland, Ohio. "Stainweld D" is intended to be used for arc welding stainless steel of the 25% chromium, 20% nickel type, such as Iron and Steel Institute No. 310. "Stainweld D" can also be used for welding various stainless steels to mild steel and for welding of steels which are air hardening and cannot be heat treated after welding, such as armor plate and similar steels.

In welding with "Stainweld D" the operator should hold arc length as short as possible without choking or sticking. In general, preparation of the work and welding procedure is similar to that used in mild steel welding. Surfaces to be welded should be free from all foreign material. Slag should be thoroughly cleaned. Thin sheets should be clamped against a copper backing to maintain alignment, reduce buckling and prevent burning through.

Electrode polarity should be positive. For best results use only enough current to obtain a free-flowing arc and proper

fusion to base metal. Following table may be used as a guide. For vertical and overhead use 5/32 in. electrode, or smaller, with currents on lower side of ranges shown:

Electrode Size.	Amperes.
3/32 in.	30– 70
⅛ in.	45– 95
5/32 in.	80–135
3/16 in.	100–165
¼ in.	140–225

"Stainweld D" comes packed in 25 lb. containers and is 11½ in. length in all sizes listed above.

» «

Temperature Indication by Means of Fusible Pellets

★ Tempils represent a new technique in temperature control. These pellets have a sharp and rapid melting action at the stated temperature. Thus, Tempil 200 melts at 200 deg. F. Tempil 300 melts at 300 deg. F., etc. Tempils are said to be accurate within 3% of the temperature which they are intended to indicate.

Each pellet is stamped with the temperature at which it melts. They liquefy sharply at the stated temperature. In addition, each range of Tempils is made in a distinguishing color for easy identification. In application Tempils are merely placed upon or against the heated object. These fusible pellets are available from Tempil Corp., 132 West 22nd St., New York City.

Tempils are available in hundred-degree ranges of 200, 300, 400 deg. F., etc., and on request may also be had in 50 deg. F. intervals. They have been employed for the past two years for controlling pre-heating temperatures in hundreds of welding operations; for indicating temperatures in hot operations; and for checking thermo-couples.

» «

Model J-12 Steelweld Bending Press

★ The Steelweld Machinery Division of The Cleveland Crane & Engineering Co., Wickliffe, Ohio, announce the addition of Model J-12 to their line of Steelweld bending presses. This press will handle plate up to 12 ft. by. 5/16 in. between housings and up to 14 ft. over total length of bed and ram. Longer plate can be handled by extending bed and ram either on one or both ends. The press illustrated has a double end extension.

Like the other Steelweld presses the J-12 has a one-piece all-welded frame which will remain rigid for the life of the machine. The ram is operated by two eccentrics, one on each side of the machine. Each eccentric is provided with three extra large main bearings and an eccentric bearing. The bearings are automatically lubricated by two oiling units mounted on either end of the machine.

All gears are protected with metal covers and shafts are located at rear of machine away from possible damage of crane hooks and bent-up plates. The machine

Model J-12 Steelweld bending press.

is streamlined in appearance. The press may be used for bending, forming, blanking, drawing, rubber-forming and multiple-punching operations. Several operations may be handled by passing the work successively through various dies set in position along the length of the machine.

Approximate overall dimensions — Length, 15 ft. 6 in.; depth, 7 ft. 4 in.; heighth, 11 ft. The usual deep 18 in. throat, which is standard for Steelwelds, is provided.

» «

Portable Electric Hammer

★ The Thor-Nado, an electric hammer featuring a new "sling-shot drive," is the latest product of the Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. Although it measures only 13½ in. long and weighs but 14 lbs., this powerful hammer is adapted to a wide variety of heavy duty applications, including star drilling, channeling, chipping, cleaning, scaling, cutting, gouging, beading, caulking, and seaming.

The outstanding feature of the new Thor-Nado is the patented "sling-shot drive," a method of driving the piston in a hammer action by means of a shock-proof rubber connection. This sling-shot drive whips the piston back and forth at a speed of 1,600 blows per minute, acting as both power accumulator and shock-absorber. There is no metal connection between the piston and the gear train and motor. The blow of the piston is not felt by the operator nor is it transmitted to the gear or motor.

Thor-Nado portable electric hammer.

The specially designed, over-capacity, universal type motor is housed at right angles to the piston barrel and transmits power through heavy-duty helical cut gears. Armature and commutator are both hand-wound. Ball bearings are sealed against dirt and dust.

Circular No. E-32, available from the manufacturer, contains additional information.

» «

Castolin—A New Low-Temperature Brazing Alloy

★ A new brazing alloy, Castolin, has recently been introduced on the American market by Societe Des Soudures, Castolin, S. A. Lausanne (Switzerland). This brazing material is available in a variety of alloys and fluxes for oxy-acetylene applications. With these alloys, brazing can be performed at unusually low temperatures. Castolin alloys are in rod form and Castolin fluxes are in powder or paste form. Due to the low temperature at which brazing can be accomplished with these alloys, overheating and warping is avoided. It is claimed that certain jobs which are very difficult to accomplish by welding can be handled satisfactorily and without difficulty by the use of these brazing alloys.

Time and money is saved, according to the manufacturer, because it is unnecessary to pre-heat parts for a long period of time. Castolin alloys for brazing steel, aluminum, brass and bronze, are available as follows:

(1) Castolin 190 for welding of aluminum and its alloys, even in the form of very thin sheets. Castolin 190 flows at 930 deg. F. and has great tensile strength (35,000 lbs./sq. in.) and durability. A welding alloy particularly for the aviation and automobile industries.

(2) Castolin 185, also called Bronzochrome, for building up on steel, cast-iron, copper, brass, bronze, etc. This alloy flows poreless at 750 deg. F. Hardness is 230 Brinell, and it can easily be machined.

(3) No. 14 for cast-iron which brazes at 900 deg. F. Tensile strength is claimed to be 47,000 to 51,000 lbs./sq. in.

(4) No. 15 for cast-iron brazes at 360 deg. F. Resistant to pressure of 8 atmospheres.

(5) No. 15 for steel brazes at 1470 deg. F. Tensile strength 115,000 lbs./sq. in. Particularly recommended for thin gauge steel.

(6) No. 18 for copper, brass, extruded bronze, brazes at 1,600 deg. F. and is poreless. Tensile strength is 65,000 lbs./sq. in.

(7) No. 210 for cast aluminum, brazes at 950 deg. F. Tensile strength 23,000 lbs./sq. in.

(8) No. 195 for die castings (white metal) brazes at 750 deg. F. Reported to have high tensile strength.

All of the above Castolin alloys and others are described in Pamphlet C-40 issued by Park Sales Co., 3 Park Place, New York City.

car) and 864 total welding man-hours per day (for 15 completed cars). Production of welded box cars has been as high as 16 complete cars per day. Modern straight-line production methods using welding can compete in speed and cost with riveted construction and turn out a product with a definitely higher strength-to-weight ratio and with better corrosion resistance at joints.

Other Equipment Builders

Mt. Vernon Car Co. has furnished 2,000 all-welded low-alloy steel underframes for Union Pacific box cars and have 2,000 more under construction. Ryan Car Co. also furnished 2,000 underframes in 1937. American Car & Foundry Co. has built several successful lightweight passenger cars and their methods of welding are similar to the "Milwaukee Road's" methods. Also, they have developed a lightweight refrigerator car.

Pullman-Standard Car & Mfg. Co. is a leader in the passenger car field and their streamlined cars are becoming more and more familiar to the public. The "Broadway Limited" (Pennsylvania R. R.) and the "Twentieth Century Limited" (New York Central R. R.) were the first low-alloy steel trains to be operated in the eastern states. These cars were built in the Pullman-Standard shops in Chicago. In the side sheathing assembly, 26 gauge sheets were corrugated to a ½-in. rectangular depth and then spot welded to the back sides of the side sheets in the spaces between the posts and horizontal members. Those corrugated sheets hold the 14-gauge side sheets flat and prevent any bulging of the panels due to the spot welding heat. The side sheets, as thus fabricated, present a smoother surface to the eye. The complete side sheathing is then placed in a flat, copper-plated vertical welding jig and the welded side frame structure clamped against the sheathing. Electrodes are applied from the inside of the car, through the posts and braces, thus showing very little evidence of spot welding.

From the foregoing, it is apparent that the welding processes for assembly of railroad cars have passed the experimental stage and are rapidly being accepted as a standardized method of construction. Also that properly made low-alloy steel welds and forms

(Continued on page 48)

Technical Literature

We have listed below brief reviews of new technical literature prepared by welding equipment manufacturers. Any literature you may desire will be sent to you free of charge. Merely check or mark serial number of paragraph on order blank at bottom of page. Students are requested to write direct to advertisers for literature.

Reducing KVA. Demand

(173) **General Electric** has issued a folder (GEA-3337) announcing a new series-capacitor equipment for reducing the kva. demand of resistance welding machines. By means of these condensers, line power-factor can be restored to unity on resistance welding circuits.

Manganese-Nickel Steel

(174) Application of Manganal manganese-nickel steel, hot rolled plates, applicator bars and wedge bars, are briefly described in a folder issued by **Stulz-Sickles Co.**

Castolin Brazing Rods

(175) A four-page folder is available describing the Castolin brazing rods and fluxes for low-temperature brazing of metals. These alloys are manufactured in Switzerland, but are available in the United States through **Park Sales Co.**, who are in charge of distribution in the United States.

Hard-Facing Rods

(176) **Dymonhard Corp. of America** has just issued a 16-page bulletin describing the complete line of Dymonhard rods for hard-facing applications. The bulletin analyzes types of abrasive wear and then suggests suitable Dymonhard facings with complete procedure data, including preheating and cooling.

Tite-Kote Welding Electrodes

(177) **Stulz-Sickles Co.** have issued a circular describing their special Tite-Kote a-c. and d-c. welding electrodes for the repair of 11 to 13½% manganese-nickel steel.

Welding Electrode Specifications

(178) **The McKay Co.** has issued a 26-page booklet covering their shielded arc welding electrodes and containing the latest (1939) joint tentative specifications for iron and steel arc welding electrodes. These new specifications were prepared by A.W.S. and A.S.T.M. committees.

Weld-O-Trol Power Switch

(179) **Westinghouse** has issued a four-page bulletin describing the construction and operating features of its Weld-O-Trol Power Switch for controlling resistance welders. In this type of switch, there are no moving parts. The current is controlled within a vacuum tube.

Victor Cutting Torch

(180) **Victor Equipment Co.** has a new flame-cutting bulletin available which presents the salient features of Victor hand and machine cutting torches. The folder is in the form of a broadside of letter file dimensions and is well illustrated in color. "Ten Sound Reasons Why" are listed in the folder in support of Victor's claims of sturdy construction and flexibility.

Hobart 40-Volt Arc Welders

(181) **Hobart Bros. Co.** has an illustrated four-page folder containing details of its 30-day free trial offer on the new Hobart Multi-Range Arc Welder. The manufacturer claims that this new welder will save 30 to 50% on welding costs. The folder also directs attention to other Hobart trade literature, including "New Profits in Job Welding," "Rules to Follow If You Have the Build-Your-Own Urge" and "The Hobart Multi-Range Welder."

THE WELDING ENGINEER March, 1940

506 So. Wabash Ave., Chicago, Ill.

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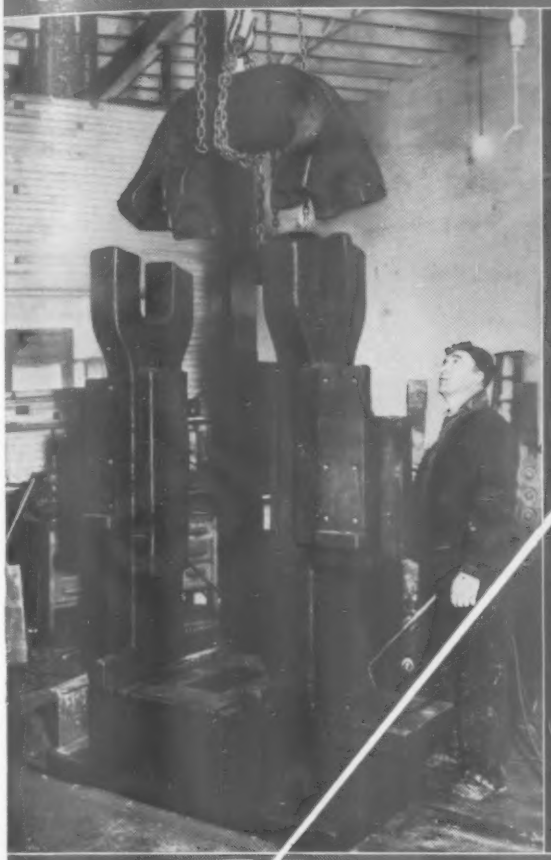

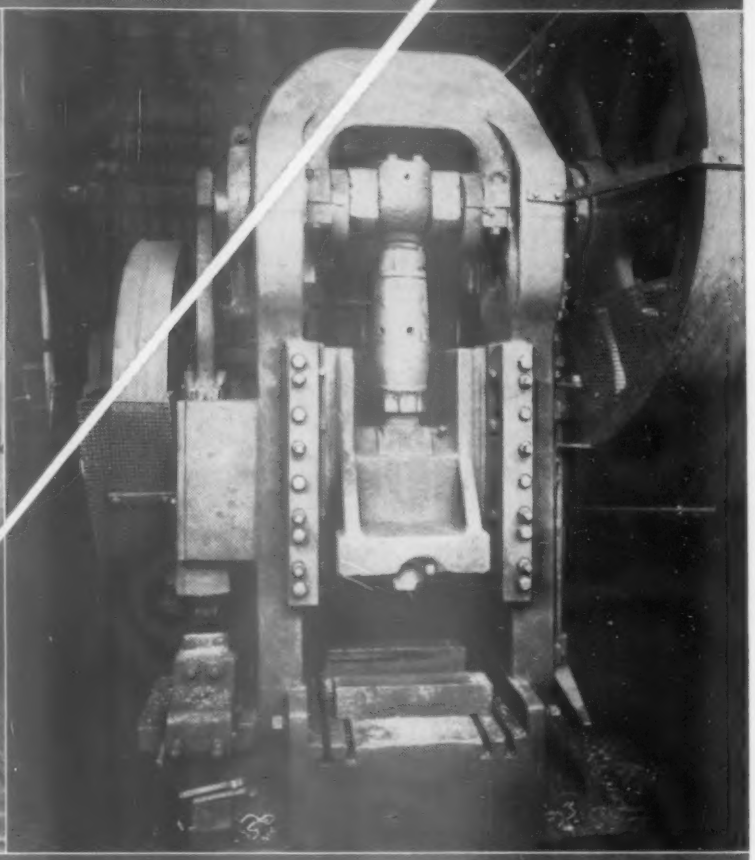

IN 46 HOURS!

Thanks to Anaconda 997 Low Fuming Welding Rod

WHEN the Hebeler Welding Company of Buffalo, New York, were called in on this emergency job, they took one look at the fractured 4½-ton punch press; promptly recommended repair welding with Anaconda 997 Low Fuming Rod . . . a high strength, tough weld metal with low fuming characteristics.

The job consumed 160 pounds of filler rod and 1,600 feet of both oxygen and acetylene. Chipping, preheating with natural gas and compressed air and other preparation required 35 hours; welding, 11 hours. The result was a strong sound weld and a happy production manager, for the downtime loss was only a fraction of what he expected.

Next time you're faced with a similar emergency, bear this story in mind. Anaconda Rods are produced in an extensive line of alloys for all kinds of welding. You can obtain them from your jobber. 40119

ANACONDA from mine to consumer

Anaconda Welding Rods

THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Connecticut

In Canada: Anaconda American Brass Ltd., New Toronto, Ont. • Subsidiary of Anaconda Copper Mining Company

as readily as plain carbon steel and from the standpoint of the car builders is as dependable and uniform as ordinary structural grades.

The only present bar to universal adoption of low-alloy steel welded car construction is the still rather open question as to the length of service to be obtained from the thinner sections before corrosion causes failure. We realize that a railroad buys its cars with a life expectancy of 25 years for underframes and 10 to 16 years for coal car and open top car bodies, and that most of them have held off on committing themselves, to the extent necessary in volume purchases of cars, until test cars have accumulated more service. But, with several coal cars and parts of cars entering their fifth year in regular, or in some cases specially drastic service, the results on which to date have been very good, we can expect from now on to see more and more freight cars of welded low-alloy, high-tensile, rust-resistant steels going into railroad service.

News of the Industry

12th Annual Welding Conference, Iowa State College

D. C. Faber, Director of Engineering Extension Service at **Iowa State College,** Ames, Iowa, announces that the 12th Annual Welding Conference will be held at Ames, during March 20-22, 1940. Following is a digest of the tentative program:

WEDNESDAY, MARCH 20

8:00 a. m.—Registration, Engineering Hall.

9:00 a. m.—Exhibits and Demonstrations, Exhibit Hall.

1:00 p. m.—Room 207, Engineering Hall.

Chairman, **R. H. Holbrook,** Iowa State College.

Recent Developments in Welding—**M. S. Hendricks,** The Welding Engineer.

Cost Reduction and Efficient Use of Materials, illustrated by celluloid models and use of polarized light—**E. W. P. Smith,** Lincoln Electric Co.

Flame-Descaling, Cleaning and Dehydrating—**W. J. Carle,** Air Reduction Sales Co.

Aluminum Fabricating Processes, Motion pictures by U. S. Bureau of Mines.

4:00 p. m.—Demonstrations, Exhibit Hall.

THURSDAY, MARCH 21

9:00 a. m.—Demonstrations, Exhibit Hall.

1:00 p. m.—Room 207, Engineering Hall.

Chairman, **L. O. Schneiderwind,** Omaha Welding Co.

Welding Specialties and the Job Shop—**J. C. Menzies,** C. E. Phillips & Co.

Boiler Welding—**C. W. Zimmer,** Hartford Steam Boiler, Inspection & Insurance Co.

Practical Discussion of Oxy-Acetylene Welding and Cutting—**C. W. Ferris,** The Linde Air Products Co.

Fitting Farm Machines with Rubber Tires—**D. K. Struthers,** Agr. Engr. Dept., I.S.C.

Welders Round Table—Oxy-acetylene Welding. Discussion Leader—**L. C. Monroe.**

4:00 p. m.—Demonstrations, Exhibit Hall.

6:30 p. m.—Welders Banquet—Direction of W. L. Allan.

FRIDAY, MARCH 22

9:00 a. m.—Room 207, Engineering Hall.

Chairman, **W. L. Immer,** General Electric Co.

Use of Liquiefied Petroleum Gases in Flame-Cutting—**H. A. Goodwin,** Bastian Blessing Co.

Control of Distortion from Welding—**W. R. Bernardi,** Westinghouse Electric & Mfg. Co.

Resistance Welding and Controls—**R. W. Breckenridge,** Mech. Engr. Dept., I. S. C.

Late Developments of the Metallizing Process—**L. E. Kunkler,** Metallizing Co. of America.

Welders Round Table—Arc Welding. Discussion Leader—**L. C. Monroe.**

1:00 p. m.—Demonstrations, Exhibit Hall.

« »

Booklet on $200,000 Industrial Progress Award Program

"$200,000 Industrial Progress Award Program" is the title of a 48-page bulletin just published by **The James F .Lincoln Arc Welding Foundation,** Cleveland, O. Official document of the 2½-year Industrial Progress Program, announced recently by the Foundation, the booklet is the culmination of more than a year of planning and development, by trustees and officers of the Foundation. It is felt by those who have examined advance copies of the booklet that the terms and conditions of award, as set forth therein, will stimulate study which will create substantial benefits. The benefits established in the booklet as a measure of progress include: reduction or elimination of hazards to safety and health through an increase in strength and durability of products and structures, greater availability of such advances through lower prices, as well as industrial benefits.

To encourage study of such fields and to secure greater benefits through industrial progress, **The James F. Lincoln Arc Welding Foundation** is sponsoring the Industrial Progress Award Program, offering 458 awards totaling $200,000.

Requests for the booklet should be addressed: Secretary, **The James F. Lincoln Arc Welding Foundation,** Cleveland, O.

ANNUAL I.A.A. MEETING

(Continued from page 28)

"Flame-Cleaning, Dehydrating and Descaling"—J. G. McGrath, Air Reduction Sales Co., New York City.

"Oxy-Acetylene Gouging—A Flame-Machining Process—R. F. Flood, service engineer, Linde Air Products Co., Chicago.

"Heavy Cutting and Applications of Oxygen Lance."

(Speaker to be announced.)

Technical Session B—Pere Marquette Room, Schroeder Hotel, 2:00 P.M.

Subject—"Speeding Fabrication and Production."

Chairman—**R. W. Sternke,** shop supt., Lakeside Steel & Bridge Co.

Vice-Chairman—**C. T. Price,** vice-president, Compressed Industrial Gases, Inc., Chicago.

"Welding and Brazing of Light Gauge Metal"—R. J. Rodgers, works manager, and **Walter R. Campbell,** supt. Electrolux Division, Servel, Inc., Evansville, Ind.

"Design and Construction of Jigs and Fixtures for Oxy-Acetylene Welding," by **John Haydock,** managing editor, "American Machinist," New York City.

"Welding for Enameling"—J. C. Lewis, president, Associated Engineers, Inc., Fort Wayne, Ind.

"Automatic Bronze-Welding," by **Rowland Hawley,** foreman, welding dept., Oilgear Co., Milwaukee, Wis.

Non-Ferrous Welding Clinic—Welding engineers of **The International Nickel Co., The Aluminum Co. of America, The American Brass Co.** and **Handy & Harman,** will hold a welding clinic in Houston, Texas, on March 22-23. Latest developments in welding technique as applied to nickel and nickel alloys, brass, copper, and aluminum and aluminum alloys will be demonstrated. All welding methods, including gas and electric, will be included. Particular reference will be made to welding problems as they affect the petroleum and other leading industries of Texas. The clinic will be held at the **Metal Goods Corp.** warehouse at 16 Drennan St., in Houston.

» «

E. W. P. Smith Talks on Stress Distribution—A group of 145 engineers, executives and men interested in welding, had an opportunity to hear **E. W. P. Smith** present an interesting, and not too technical discussion of the subject of "Stress Distribution" by means of rubber models and celluloid models (using polarized light). This meeting was held at the Chicago Bridge & Iron Co., 1305 W. 105th St., Chicago, 7:30 p.m. on March 6th. In his talk, "Ed" Smith, who is consulting engineer for the Lincoln Electric Co., Cleveland, Ohio, emphasized the very important fact that calculations of average stress in welded joints do not give, in all cases, the correct value of stress inten-

sity, because it can be shown by means of these simple elastic models that there is concentration of stress wherever there is a sharp change of section. In other words, whenever there is a notch effect, there is bound to be a high stress concentration. Accordingly, in welded design, it is always good practice to provide smooth contours and avoid sharp angles wherever possible.

» «

The Balbach Co. Welding Conference—In spite of extremely cold weather, **The Balbach Co.**, 1201 California St., Omaha, Neb., reports that a total of 350 welding-minded men attended their recent welding conference. These conferences are conducted for the purpose of giving Balbach customers as much information as possible regarding the newer developments of welding. In addition to welding demonstrations, Balbach customers were shown demonstrations of: dehydrating and descaling, oxy-propane flame-cutting, deseaming of steel billets, and rivet washing (using a hand torch), Stooditing of plow shares and farm implements. The details of the conference were arranged by **George A. Thrapp**, sales manager of the Balbach Co.

« »

Five-Day Intensive Course Offered in Welding Engineering

Through the joint efforts of **The Lincoln Electric Co.**, Cleveland, Ohio, and the **John Huntington Polytechnic Institute**, 3133 Euclid Ave., Cleveland, Ohio, a series of special 5-day courses in the engineering fundamentals of arc welding has been arranged. Starting dates of each 5-day series is given at the end of the outline published herewith. The course is designed for supervisors, engineers, designers, superintendents, managers and executives concerned with or interested in welding.

Its purpose is to create a desire to design or to redesign, from castings, or riveted construction, and to use welding to reduce costs. It outlines general principles of welding design and fabrication. These principles combined with the knowledge and experience of the trained engineer show how to design and fabricate welded machinery and structures.

MONDAY

10:30 a. m. (Talk)—The tools of welding, Welding generators. The Arc—characteristics—requirements—welding generators—volt ampere curves—varying energy curves—constant energy curves—controls—direct current—alternating current.

1:00 p. m. (Shop)—Demonstration and use of generator controls. Lay uniform bead at least 6 in. long.

8:00 p. m. (Lecture)—The tools of welding, Weld metal. The shielded arc—quality metal and welded joints—comparison to cast iron—value and use in design.

TUESDAY

10:30 a. m. (Talk)—The tools of welding, Welding of metals. Their characteristics, classification — steel — cast-iron — wrought iron—malleable iron—copper—aluminum—stainless steel.

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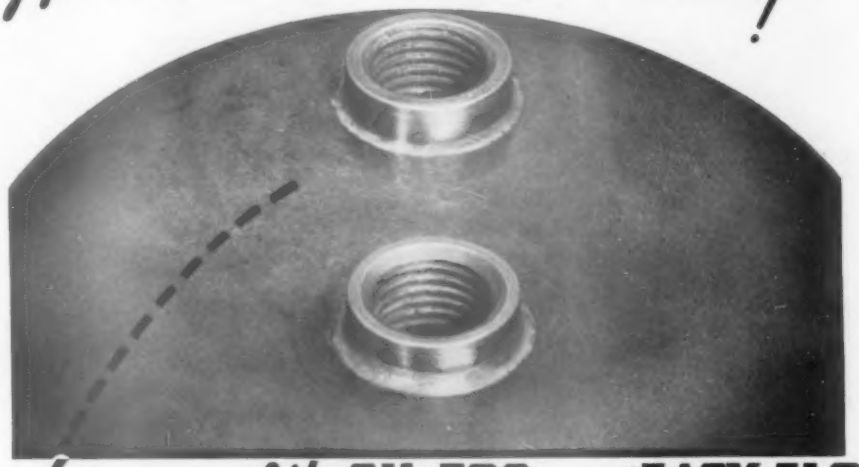

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The Easy-Flo joints in the part shown—taken right from the production line—are typical examples. Sil-Fos and Easy-Flo make neat, smooth joints like this because they are extremely fluid and penetrate with surprising speed **into** the joint, little or none staying outside to mar appearance.

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You save labor, gases and materials with Sil-Fos and Easy-Flo. These economies, added to big savings in finishing, make it **profitable** to braze with Sil-Fos and Easy-Flo—and particularly so where appearance counts. Try *Sil-Fos or *Easy-Flo on **one** job. Write us for full details.

***Use SIL-FOS** *for reliable joints between copper, brass and bronze. It does a fine job at 1300 Deg. F.*

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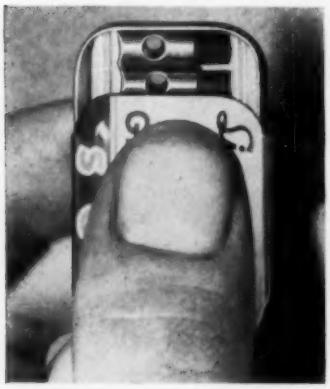

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1:00 p. m. (Shop)—Demonstration welding of different metals.

8:00 p. m. (Lecture)—Design Methods: Cast-iron to steel—simple method of designing from cast-iron to steel—most economical sections—reductions of cost—improved service—reduction of inventory.

WEDNESDAY

10:30 a. m. (Talk)—Design Methods: Inspection of welds—qualification of operators—method of inspecting welds—easy, low cost method of qualifying operators.

1:00 p. m. (Shop) — Demonstration of weld inspection method, and qualification of operators.

8:00 p. m. (Lecture)—Design Methods—Stress distribution: Uniform stress reduces costs—welded joints—excellent stress distribution. (Studied and illustrated by rubber models.)

THURSDAY

10:30 a. m. (Talk)—Automatic welding: Uses—cost—types of equipment.

1:00 p. m. (Shop)—Demonstration of automatic welding: Shop inspection trip.

8:00 p. m. (Lecture)—Design Methods—Stress distribution: Uniform stress reduces costs—simple application of polarized light. (Dinner meeting.)

FRIDAY

10:30 a. m. (Talk)—Design Methods: Expansion—contraction—external deformation—simple, general rules—surfacing—economy of.

1:00 p. m. (Shop)—Demonstration—Special electrodes for surfacing.

8:00 p. m. (Lecture)—Design Methods—Costs: Factors affecting costs—control of these—reduction of costs by welding—simple curve for determining costs.

Registration—Monday, 10:00 a. m., at The Lincoln Electric Co. plant in person or in advance by mail. A registration fee of $10 will be charged.

Dates—Courses will start in Cleveland, Ohio, on following Mondays: March 25, 1940; April 22, 1940; May 27, 1940.

Personals

John K. Hodnette, transformer engineer of **Westinghouse Electric & Mfg. Co.,** has been honored by his election as a "Modern Pioneer of the American Frontier of Industry," for his outstanding work on development of the completely self-protected transformer. This award was given Mr. Hodnette by the National Association of Manufacturers and is a part of its program of honoring important achievements in celebration of the 150th anniversary of the founding of the United States Patent System. Coming to Westinghouse in 1923, he worked first in the test department and as an engineer in the materials and process department, before beginning his work on distribution transformers in 1929.

» «

Lens Authority Honored—In recognition of his numerous contributions in the field of optical science, **Dr. E. D. Tillyer,** American Optical Co. research scientist and lens authority, received an award recently from the **National Association of Manufacturers** designating him as a "modern pioneer on the American frontier of industry." The award was presented at a meeting of industrialists and scientists held in Hotel Copley-Plaza in Boston, Mass. A total of 125 patents has been issued to Dr. Tillyer.

« »

Lamme Medal Awarded to Norman W. Storer—The 1939 Lamme Medal for the **American Institute of Electrical Engineers** has been awarded to **Norman W. Storer,** retired consulting railway engineer, **Westinghouse Electric & Mfg. Co.,** East Pittsburgh, Pa., "for pioneering development and application of equipment for electrical traction." The medal and certificate will be presented to him at the annual summer convention of the Institute, which is to be held in Swampscott, Mass., June 24-28, 1940.

The Lamme Medal was founded as a result of a bequest of **Benjamin G. Lamme,** chief engineer of the Westinghouse Company, who died on July 8, 1924, to provide for the award by the Institute of a gold medal annually to a member of the American Institute of Electrical En-

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gineers, "who has shown meritorious achievement in the development of electrical apparatus or machinery" and for the award of two such medals in some years if the accumulation from the funds warrants.

Trade News

Bridgeport Brass Reports Extensive Plant Modernization—In his annual report to the stockholders, **Ralph E. Day**, president of Bridgeport Brass Co., stated: "The pattern of monthly operating results of your company during 1939 was, in general, one of gradual betterment as the year progressed, with the rate and extent of this improvement sharply accentuated in the early Fall by a rapid increase in activity coincident with the marked upturn in general business. This development necessitated an immediate increase in production schedules and in personnel, and resulted in last quarter operations at near-capacity levels."

Mr. Day stated that at the beginning of 1940 the company is looking forward to greater accomplishment, because of the extensive program of modernization which has taken place during the past three years and has reached into practically every department of the plants. This year the company is celebrating its 75th anniversary.

» «

Twenty-Two G-E Employees Receive Coffin Awards

Twenty-two employees of the **General Electric Co.**, located in eight different works and offices of the organization, recently received **Charles A. Coffin Foundation Awards.** Thus they joined a group of more than 500 other employees who in the past 17 years have received this award, the highest honor conferred by the company on its employees. The 22 awards were made for 17 distinct accomplishments, four being made jointly to two or more individuals who co-operated in the work which brought them recognition. Eight of the men are classed as factory workers, 12 as engineers, and 2 as commercial men.

The purpose of the Foundation awards to employees is two-fold: (1) to perpetuate the memory of Charles A. Coffin, organizer and first president of the General Electric Co., and (2) to recognize annually such employees whose accomplishments are sufficiently outstanding as to reflect the qualities of the founder of the company. Every employee of General Electric is eligible for consideration.

» «

Net Earnings Up 49%—Preliminary results of General Electric operations for the year 1939 show sales billed amounting to $304,680,000, which compares with $259,484,000 for 1938, an increase of 17%. Orders received in 1939 amounted to $360,748,000, or 43% more than in 1938. Net income for 1939, after provision for all charges, amounted to $41,236,000, and was equivalent to $1.43 a share of common stock, compared with 96 cents a share in 1938, an increase of 49%.

» «

New Type of Copper Perfected—Announcement of a new type of copper, after a ten year research and development program, was made recently by the Phelps Dodge Copper Products Corp., 40 Wall St., New York City. The new copper is known as "PDCP," created by research effort to meet the need of the electrical industry for a copper of special characteristics. Greater conducting power, ductility, fatigue resistance and surface quality are the major characteristics claimed for this new metal.

The improved metal is made without melting from electrolytic cathode copper, which is plastically converted by tremendous pressure in a reducing atmosphere at elevated temperature into smooth, dense copper bar, rod, strip or other desired shapes. Basically of the oxygen-free type, it is the only solid copper which is not melted, subsequent to the electrolytic purification process. Hence, the purity of electrolytic cathode copper is not only retained, but is enhanced at the high temperature of the reducing gas used in the process.

Ductility greater than ordinary copper permits sharper bends, easier forming and drawing. The metal is said to approach the malleability of gold. This property, combined with greater electrical conductivity, has made the new copper especially

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TITAN Alloys—doubly-deoxidized to protect against formation of gas and oxides—give the best results for all oxy-acetylene welding and brazing applications:

Penn Bronze—is a general purpose rod. It is low melting (1620° F.) and tins easily and uniformly on galvanized, malleable or wrought iron as well as steel, brass, bronze and any other non-leaded metal with a melting point above 1850° F. It makes tough high-strength welds of high ductility, immune to strain hardening and with great abrasion and corrosion resistance.

Titan Manganese Bronze—is used where both hard and tough welds are desired. Although this is a general purpose rod, it is especially recommended for cast iron. It is free flowing and gives extremely dense, non-porous welds.

Titan Bronze—is a tin bronze with uses and characteristics similar to the manganese alloy; penetrates seams and crevices readily.

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This newly-introduced electrode possesses a SPECIAL SELF-PEELING FLUX COATING that works equally well with A.C. and D.C. and in no way retards the quick cooling of the weld deposit.

Insures the same ductility and toughness found in deposits made with MANGANAL Bare Welding Electrodes. Weld deposits can be peened while hot without the danger of pounding slag into the weld metal.

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suitable for use in a multitude of complicated electrical parts and devices.

A new manufacturing unit was constructed at the Bayway mills of the Phelps Dodge Copper Products Corp. for exclusive production of this "PDCP" copper in various commercial shapes and sections.

« »

The Champion Rivet Co., Cleveland, Ohio, has just concluded arrangements with the **United States Steel Export Co.,** 30 Church St., New York City, to handle exclusive sale of their Champion welding electrodes for export throughout the world.

« »

Contract Engineering Corp. — Effective March 1, 1940, the firm of **Contract Welders, Inc.,** has changed its name to **Contract Engineering Corp.,** 2545 E. 79th St., Cleveland, Ohio. **E. R. Benedict,** president, reports that there will be no change in personnel or management. This concern is engaged in the business of designing and building machinery, industrial and power piping, structural fabrication and erection, and air-conditioning equipment.

» «

Expanded Manufacturing Facilities—The Foote Mineral Co. of Philadelphia, Pa., have just completed a modern, three story, fireproof grinding unit and warehouse. Located at Queen St. and Mermaid Lane, this new plant has been equipped with every facility for rapid movement of large tonnages of ores, including a new railroad siding and truck platform. The increased capacity of the mill and additional warehouse space will enable the Foote Mineral Co. to stock greater quantities of raw materials and provides more storage space for goods under contract. The new grinding unit is designed to produce a greater uniformity of close granulation as well as a higher percentage of recovery.

A. W. S. Activities

Los Angeles Section A. W. S.—Leon C. Bibber, welding engineer of **Carnegie-Illinois Steel Corp.,** spoke on "Experimental Background to Welded Design," basing his lecture on the results of 15 years of research to establish correct welded design principles.

At the same meeting, **R. F. Helmkamp,** engineer, **Air Reduction Sales Co.,** presented a paper on "Plate Edge Preparation."

» «

Philadelphia Section A. W. S.—"Welding of Copper-Base Alloys" was the subject of a paper by **Ira T. Hook,** research engineer of **American Brass Co.,** at the February 19th meeting held at the Engineers' Club, 1317 Spruce St., Philadelphia.

» «

New York Section A.W.S.—E. C. Rechtin, assistant to vice-president, **Bethlehem Steel Co.,** spoke on the subject "Welding and Shipbuilding." In his talk, Mr. Rechtin told what effects welding had on the economics of ship construction and he showed the latest applications of automatic welding as used in Bethlehem Steel Co. shipyards. **J. L. Wilson,** assistant chief surveyor, American Bureau of Shipping, was chairman of the meeting.

» «

Chicago Section A.W.S.—At the regular meeting March 15, held at the Chicago Lighting Institute, 20 N. Wacker Drive, **Charles H. Jennings,** research engineer, **Westinghouse Electric & Mfg. Co.,** discussed distortion problems and how, by careful consideration of design and weld location, as well as sequence of welding, distortion problems can be greatly minimized.

Milwaukee Section A. W. S.—"Modern Steel Structures" was the subject of a paper by **H. W. Lawson** of **Bethlehem Steel Co.,** at the February 23rd meeting, held at the City Club, 756 N. Milwaukee St. Mr. Lawson discussed welded structural details, pointing out what to avoid and what to adopt in the design of welded structures. He discussed the need for standardized details. Prior to the technical meeting, **N. L. Boardman,** of the Federal Bureau of Investigation, spoke on the "Work and Function of the F.B.I."

« »

Milwaukee Section A.W.S.—**R. T. Gillette,** resistance welding engineer, **General Electric Co.,** presented a paper, "Recent Improvements in Manufacturing by Resistance Welding" at the regular monthly meeting held March 13, at Hotel Pfister, 424 E. Wisconsin Avenue.

» «

Detroit Section A.W.S.—At the regular monthly meeting, March 15, **Leon C. Bibber,** welding engineer of **Carnegie-Illinois Steel Corp.,** spoke on, "Welded Joints, Which Ones to Use and Why." A motion picture on the Unionmelt welding process was also shown through courtesy of the **Linde Air Products Co.** Detroit Section meetings are held at the Detroit-Leland hotel.

» «

Cleveland Section A.W.S.—"Welding of Large Steam Shovels" was the subject presented by **H. L. Rogers,** welding superintendent, **Marion Steam Shovel Co.** of Marion, Ohio, at the regular monthly meeting, March 13, held at Fenn College, East 24th St. and Euclid Ave. Mr. Rogers discussed the applications of flame-cutting, forging and arc welding in the replacement of heavy steel castings with arc welded plate fabrication.

» «

Cleveland Section A.W.S. Will Hold Spring Educational Course—A series of six lectures will be presented by **O. N. Stone,** engineer with **Wellman Engineering Co.,** Cleveland. These educational lectures will be given at 8:15 P. M. on the dates indicated below, all meetings being held at Fenn College, East 24th St. and Euclid Ave. These lectures are free to all members of the Cleveland Section, also to Cleveland Section "affiliates." Others may attend the course upon payment of

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$2.50 registration fee. Following are the subjects to be covered:

April 1—Elements of Structural Welding Design.
April 8—Examples of Structural Welding Applied to Buildings.
April 15—Examples of Welding Applied to Tanks and Pressure Vessels.
April 22—Elements of Mechanical Welding Design.
April 29—Examples of Welding Applied to Machine Parts Subjected to Static Loads.
May 6—Examples of Welding Applied to Machine Parts Subjected to Dynamic Loads.

Current Reviews

Mechanical Testing of Welds—The March, 1940, issue of The Welding Journal, published by the **American Welding Society**, 33 W. 39th St., New York City, contains a committee report headed, "Tentative Standard Methods for Mechanical Testing of Welds." This report should be of interest to those who are directly concerned with weld testing.

« »

Welded Structural Details—American Institute of Steel Construction, 101 Park Ave., New York City, has just issued a bulletin covering "Recommended Fundamental Principles, Tentative Minimum Requirements and Tentative Standard Welded Connections for Tier Buildings." These new tentative standards have been developed by a special committee of the Institute which was appointed for the purpose by the Board of Directors of the Institute in 1938. The Recommended Tentative Standard Details contained in the bulletin, will be published in a forthcoming issue of **The Welding Engineer.**

« »

Alloys of Iron Research—American industry has acquired a vast store of organized knowledge of steel and iron, and their alloys as the result of 10 yrs. of research just completed by the Iron Alloys Committee of the Engineering Foundation, 29 West 39th St., New York City. With the co-operation of 88 manufacturers, research institutes, technical societies, and federal bureaus, and at a cost of $271,700, hitherto inaccessible information has been assembled from the scientific and technical literature of many nations.

The work, first critical review of its kind ever attempted, will be of incalculable value to the industries producing and consuming iron and steel, according to a report of the Committee. Interest in alloy steels, alloy irons, and alloying materials is growing rapidly and the use of these ferrous metals is increasing through spread of knowledge of their properties, it is pointed out.

Approximately 10,000 papers have been read, and 20,000 abstracts have been prepared. Out of this tremendous mass of material, embracing progress recorded since 1890, ten monographs containing 5,630 pages, have been issued.

Recent Patents

Copies of any of the patents described in this section can be obtained at a cost of 10 cents each, by writing to the Superintendent of Documents, Government Printing Office, Washington, D. C. When ordering copies be sure to state the patent number.

Collar Welding Jig

2,187,878. **Arthur M. Hill** and **Jennins B. Harshman**, Tulsa, Okla., assigned to **Stanolind Pipe Line Co.**, Tulsa, Okla. Filed Feb. 27, 1937. Issued Jan. 23, 1940. A device for holding or pulling together adjacent portions of two linearly-disposed members to be welded. The jig has an encompassing collar for receiving each of the portions, the collar being divided into a number of separate portions to facilitate ready installation. Wedge-shaped gripping jaws are provided on the inner surfaces of the collars. A tightening element pulls the two collars toward each other and causes the gripping jaws to hold and pull the members to be welded together. The tightening element also serves to hold the separable portions of the collars together.

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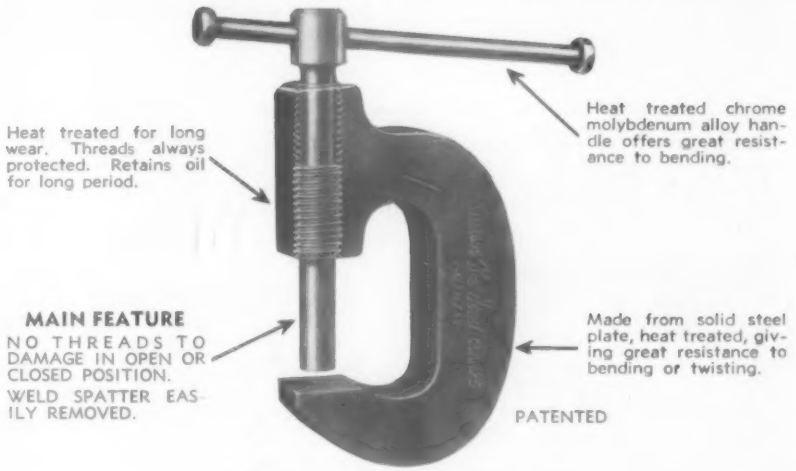
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Eyeshield Head Frame

2,187,932. **Leo R. Cornell,** Berkeley, Calif., assigned in part to **G. B. Lenz.** Filed Mar. 27, 1936. Issued Jan. 23, 1940. A headgear is described for supporting eyeshields or goggles during welding. A novel arrangement of structure permits the placement of the goggles in shielding position by a mere nod of the wearer's head.

» «

Welding Rod Reel

2,188,070. **Albert W. Baird,** Elizabeth, N. J., and **Frederick G. Outcalt,** New Rochelle, N. Y., assigned to **The Linde Air Products Co.,** of Ohio. Filed Nov. 19, 1937. Issued Jan. 23, 1940. This patent points out that to obtain optimum results, a magazine or reel for storing and supplying welding rod or wire should be non-rotatable. It should also have a large capacity and be capable of use with bundled or coated wire unsupported on spools or other centering devices. The magazine should offer a minimum of friction to the passage of the rod or wire therefrom, in order not to strain unduly the rod straightening and feeding means of the automatic welding machine, while at the same time regulating the rate of withdrawal of the rod or wire. The magazine should also permit ready insertion of new rod. The reel of the patent has these desirable characteristics. In addition it is adapted for mounting on the welding machine, or its moving mechanism, so as to move with the welder as a unit.

Welding Chill Ring

2,188,925. **Bela Ronay,** Annapolis, Md. Filed Feb. 24, 1939. Issued Feb. 6, 1940. A method of preparing two pipe ends for welding into a single joint, which involves inserting a frusto-conical chill ring section into each pipe end, with its smaller fitting inside of the pipe end and its greater diameter flush with the pipe end. The smaller and greater diameters of the chill ring portion are said to encompass the limits of tolerance of the pipe diameter. The material of the chill ring section is semi-plastic, consisting of approximately 45% alumina, 45% confectioner's sugar, and 10% graphite. The two pipe ends are placed in abutting relation, with the flush ends of the chill ring sections abutting, to form a properly joined complete chill ring.

» «

Carriage Mounted Torch

2,189,140. **John C. Glaum, Jr.,** Chicago, Ill., assigned to **Compressed Industrial Gases, Inc.,** of Delaware. Filed April 2, 1938. Issued Feb. 6, 1940. The patentee describes a torch mounted on a motor-driven carriage. The torch is guided automatically along a predetermined traced course. The patent relates specifically to a gas cutting torch. However, the patent appears to be of additional interest, insofar as its possible adaptation for similarly mounted welding flames for welding along a predetermined path.

Welded Gusset Fitting

2,189,201. **Fredric E. Flader,** Kenmore, N. Y., assigned to **Curtiss-Wright Corp.,** of Delaware. Filed Aug. 17, 1937. Issued Feb. 6, 1940. For welding a number of intersecting members, the inventor provides a gusset joint. The joint is so constructed as to avoid excessive heating during welding and is designed to more favorably distribute the load over a greater area of the welded joint, without substantially increasing the total linear dimension of the weld. The joint employs a V-shaped, or double-walled gusset plate, instead of the flat triangular gussets used heretofore. A continuous line of weld metal around the periphery of the gusset joins the gusset to the adjacent joint members.

» «

Arc Welding System

2,189,326. **Ernest Riemenschneider,** Lakewood, Ohio, assigned to **The Midland Steel Products Co.,** Ohio. Filed Sept. 11, 1935. Issued Feb. 6, 1940. An arc welding system having a plurality of welding units, each including a welding circuit and an adjustable electrode. A control circuit is provided for each unit, including a reversible motor to adjust the electrode. Interrupter elements are connected to the control circuits for the plurality of units, these interrupter elements being capable of cutting into and out of any one or more of the control circuits.

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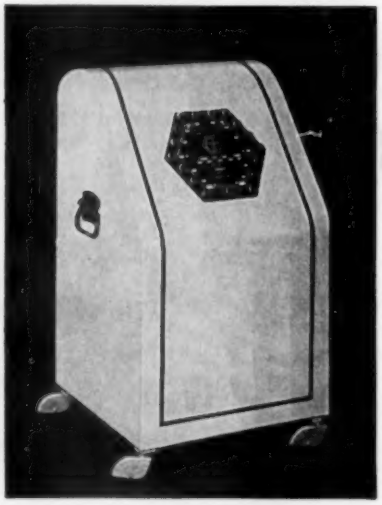

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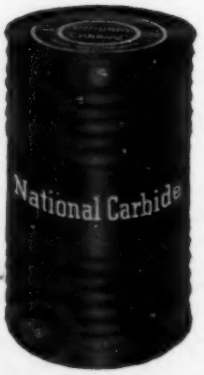

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Tubular Welding

2,189,351. **George W. Sower,** Cleveland, Ohio, assigned to **Republic Steel Corp.,** of Ohio. Filed Dec. 13, 1938. Issued Feb. 6, 1940. It is the purpose of this patent to remove particles of molten metal which pass into the interior of tubular articles during welding. A method is shown for collecting, congealing, and removing such particles. The invention employs a hollow unit which is positioned within the tubular article while it is being welded, the unit having an open end situated beneath the zone of welding. A stream of air congeals the particles of metal, the air carrying the congealed particles through the tube and away from the welding zone. Attention is also directed to patent No. 2,189,339 for an apparatus for carrying out a similar particle-removing operation.

» «

Welding Hard Metal

2,189,595. **Edward F. Smith,** Chicago, Ill., assigned to **Haynes Stellite Co.,** of Indiana. Filed May 20, 1937. Issued Feb. 6, 1940. In many fusion deposition welding processes, including particularly the deposition of hard, wear-resistant metal from a welding rod onto a softer, tougher metal, it is necessary to preheat the article to be surfaced and to maintain it at a relatively high temperature throughout the entire operation, in order to prevent stresses which would cause the article to crack. The inventor maintains a substantially uniform high temperature by electrically heating the article independently of the welding heat. The heating current is passed intermittently to preheat the article to be welded to between 700 and 900 deg. F. The current is employed during the deposition of welding metal. A specific metal is disclosed as one of the cobalt-chromium-tungsten type.

» «

Safety Control

2,189,606. **George E. King,** Wilkinsburg, Pa., assigned to **Westinghouse Electric & Mfg. Co.,** Pittsburgh, Pa. Filed Dec. 17, 1936. Issued Feb. 6, 1940. A safety control is shown for welding systems employing alternating current and a high open-circuit voltage. Such high voltages are hazardous to the operator, particular danger being present when an operator changes electrodes while the machine is in operation. The safety control of this patent functions positively and immediately to conect the electrode to the full circuit voltage, only when the electrode is brought into engagement with the work. The control also functions to disconnect the electrode from the full circuit voltage at the expiration of a predetermined time interval after the cessation of the welding operation. The control also prevents a high voltage reaching the electrode in the event of failure in the control mechanism.

» «

Gun-Type Spot Welder

2,189,784. **Merrill L. Eckman,** Cleveland, Ohio, assigned to **American Coach & Body Co.,** Ohio. Filed Mar. 5, 1938. Issued Feb. 13, 1940. An arrangement is shown for altering electrode pressure on the work independently of the force exerted by the operator's hands. An operating level for a pressure-applying mechanism provides for relative movement of the hand-hold members.

» «

Feeding Device for Rods

2,190,150. **James E. Fay,** Middletown, Ohio. Filed May 13, 1939. Issued Feb. 13, 1940. An apparatus is described for feeding short lengths of electrodes continuously in an automatic arc welding apparatus. A magazine holds a number of lengths of electrode. Magnetic means are employed to withdraw the electrodes from the magazine and to insert the electrodes in sequence into feed rollers which carry them to the welding tip. The rods follow each other in abutting relation. The welding operation need not be discontinued since there is a continuous supply of welding rod. This feed avoids the necessity of joining individual lengths of electrode.

» «

Welding Thin Sheets

2,190,621. **Ernst Baer,** Berlin, Germany. Filed May 18, 1938. Issued Feb. 13, 1940. This patent relates to a process for welding a number of thin pieces of metal and a metal carrier by spot welding. The patentee contacts the welding electrode with the carrier with the end of each sheet during the welding operation.

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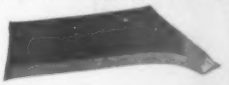

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